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World Food Forum

PROCEEDINGS

Commemorating

Centennial U.S. Department of Agriculture, 1862-1962

May 15-16-17, 1962 Washington, D.C.

**United States
Department of
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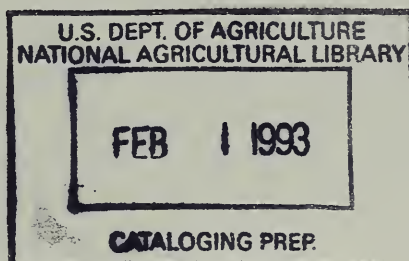
WORLD FOOD FORUM PROCEEDINGS

The Inaugural Event

Commemorating the 100th Anniversary of

THE UNITED STATES DEPARTMENT OF AGRICULTURE

May 15, 1962



Washington, D.C. Issued January, 1963

THE PRESIDENT . . .



welcomes a group of World Food Forum participants.

**REMARKS
OF THE PRESIDENT
TO PARTICIPANTS OF THE
WORLD FOOD FORUM**

I want to express my welcome to all of you, those of you who are from the Department, those of you who are from American universities, land-grant colleges, and others—and those of you, especially, who have come from abroad, from Scotland, from The Hague, from Belgium, from New Zealand, from Australia, from Cairo, all of this indicates what a great international challenge and opportunity that we have.

Our agricultural problems and opportunities are different from those of much of the world. We have a tremendous capacity to produce, which has really been the most extraordinary revolution, really, in a sense, of a kind that we have had in the last fifteen years. In other countries their problem has been an inadequacy of supply. So how we shall maintain our production, how we shall improve our consumption, how we shall maintain the income of our farmers, how we shall take care of those who no longer are needed to produce our food, and how other sections of the world shall be able to market their surpluses in those countries where they have them, in concert with us, in a way which serves the very basic needs of the people of the world, all that is worth your attention and effort.

So we are very proud to have you here. We are very glad that this is recognized, on this occasion, as a world problem. We are anxious to work in the closest concert with you. None of us feels very happy at having food stored away while others need it, and the way that we can solve that problem is a very human one which transcends national frontiers.

So gentlemen and ladies, you are most welcome here on this occasion, because this is a matter of particular concern to this Administration. We are glad to see you. Thank you.

THE WHITE HOUSE
WASHINGTON
May 15, 1962

Dear Senator Ellender:

I regret my inability to be present at the dinner of the World Food Forum, but I hope that you will express, on my behalf, a most cordial greeting to those attending the dinner.

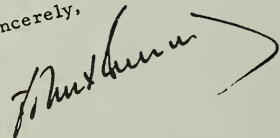
It is significant that the Department of Agriculture has chosen to mark its 100th Anniversary by an international assembly of distinguished scientists and administrators concerned not only with the agriculture of our own Nation but with the agriculture of the world. The past has been an era of rapid technological development in which we have achieved the enviable goal of food abundance for ourselves. In the years ahead, we must seek the greater goal of abundant food for all. This will require a multi-nation effort in which we shall share freely the knowledge, the skill, and the ingenuity that is available.

One hundred years ago today, President Lincoln signed the Act of Congress creating the United States Department of Agriculture. In the months that followed, there was also enacted into law the Homestead Act, opening our hinterland to settlement, and the Morrill Act, creating a system of land grant colleges. These three Acts signaled the beginning of the rich traditions of American farm life which we know today. As we move into the next century of development, those traditions will serve as the basis for the ultimate conquest of hunger -- man's oldest, persistent enemy.

No one speaks for American agriculture today with more confidence or authority than Secretary Freeman, who is entrusted with the important and difficult task of guiding our agriculture into the new economy of abundance which its own productivity has created. I could have found no one of stronger conviction or greater dedication to the national interest to take my place tonight than Secretary Freeman.

I congratulate the Department of Agriculture and the Land Grant Colleges of the Nation on this milestone.

Sincerely,



Honorable Allen J. Ellender
United States Senate
Washington, D. C.

FOREWORD

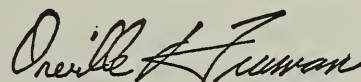
The World Food Forum surveyed a century of the past and searched far into the future. It stirred our imaginations and raised our eyes to new perspectives of agricultural science and the ultimate assurance of food in plenty for all the world.

The papers recorded in these Proceedings represent an assessment of progress in the last hundred years and a challenge to even greater progress in the century ahead. No man can predict what that century will bring. But the achievement of the last twenty-five years in the science of agriculture holds out the promise that our age of technological innovation will see the end of famine, of hunger, of undernourishment on this planet.

A hundred years from now, when learned men meet again to discuss the state of mankind's food supply, the full measure of this country's contribution to agricultural progress will be fully understood. In the long view of that century-to-come, it may well be said that our most significant contribution to man's ultimate well-being—more meaningful in terms of elemental human needs than any other scientific attainment—was our contribution to the science of agriculture. For then, as now, man will need before all else, the produce of the soil.

The Department of Agriculture takes great pride in the steady progress of its work over the span of a hundred years. It looks forward with confident anticipation to continued advances in research and service to the people of this country and the world.

These Proceedings, I believe, capture some of the Department's sense of achievement and record many of its tangible accomplishments. What is perhaps more important, they open new challenges and offer new opportunities for a second century of productive useful work.

A handwritten signature in dark ink, reading "Orville H. Freeman". The signature is fluid and cursive, with the first name "Orville" being more prominent and the last name "Freeman" following in a similar style.

Secretary of Agriculture.

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FIRST PLENARY

In this opening session four speakers evaluate the progress of American agriculture. It is a look backward in a sense; but it is also an appraisal of present-day opportunities. It relates agricultural progress to world affairs; it examines agricultural abundance as an instrument of peace; and it shows how agriculture is a moving force in economic growth.

AGRICULTURE AND AMERICAN LIFE, 1862-1962

Challenges Ahead—Introductory Remarks

Orville L. Freeman, *Secretary of Agriculture*

I TAKE great pleasure in welcoming you to the World Food Forum, an occasion that opens our commemoration of the Centennial of the U.S. Department of Agriculture. Today we pay tribute to 100 years of progress. But the highest purpose of our observance of this Centennial is to evaluate the achievements of the past in terms of the needs, opportunities, and challenges of the future.

We have much to be thankful for in the achievements of the past. American agriculture has, during the past century, created an abundance in the basic needs of human beings for food and fiber of which earlier generations dared not even dream.

Fewer than one-tenth of our labor force, using only two-thirds of our cropland acres, now provide plenty for all of our people—enough to spare and to share. The consumers of this Nation now enjoy a greater supply and variety of better food at lower real cost than any other people in history. In addition, last year we exported a record total of \$5 billion worth of agricultural products, 30 percent of which moved under the food-for-peace program. Under this assistance program we have sent abroad more than \$9.5 billion worth during the past 7 years.

This amazing increase in productivity is only at the beginning of its rising curve of acceleration. During the 90 years between 1860 and 1950, the number of persons supplied by one farm worker increased from 4½ to 14½, a threefold increase in 90 years. But during the 10 short years between 1950 and 1960 that number nearly doubled, from 14½ to 27.

And even within that decade just past, agricultural productivity increased faster during the last half than during the first half of that period. It is the policy of this Government—this administration—to see that this abundant agricultural productivity is balanced and utilized most effectively in the interest of the people of this Nation and our relationships with the rest of the world.

For the past, this agricultural productivity has given a dynamic impetus to the economic growth of our Nation, an invaluable boost to the American standard of living, and an opportunity to assist millions of people in other nations.

For the future, this productivity presents to American agriculture, and to this Nation, and to other nations that share in this abundance, the greatest challenge in all our history. The scientific and technological revolution in agriculture has opened the door to the possibility of plenty in basic human needs—a potential for plenty under which no man, woman, or child need be in want. Yet only a few nations in the world today, with fewer than one-third of the world's population, have been able to enter through that door.

The challenge we face is to open wider the gate to this era of abundance. The challenge is not only a more effective distribution of what we produce, it also includes a sharing of the know-how that makes this productivity possible.

American pioneers overcame tough, hard obstacles in conquering the physical frontiers of the past century. Ahead lie frontiers in human relations that are even more hazardous and more difficult.

If we are to meet successfully the challenge of these frontiers, we must seek to apply the best of our knowledge, experience, and resources to the needs of the future. We must cooperate with all other nations that seek the same goals.

As we seek to meet the challenge of this new age of space, of power, and of potential plenty, we must be ready to cooperate to direct the power that man has created in the best interest of mankind. The future may depend on how well we succeed.

Let us resolve to meet that challenge.

Let it never be said that, in these critical years of the scientific revolution, we were able to send men into space but unable to put bread and milk into the hands of hungry children.

Let it never be said that we had the scientific knowledge and the technical skill to produce power sufficient to destroy civilization, but that we did not have the ability, the vision, and the will to use that knowledge to produce and distribute the abundance that science and technology now offer to a world at peace.

American Agriculture as an Influence in World Affairs

Stuart Symington

*United States Senate*¹

IT IS A PRIVILEGE to speak to such a distinguished group of the leaders of world agriculture; and it is rare that such an accumulation of knowledge of agriculture has been gathered under one roof.

Today marks the opening of the Centennial celebration of the creation of our Department of Agriculture. One hundred years ago today President Abraham Lincoln signed the bill establishing this Department.

The fruits of this act have benefited not only the people of this country, but people all over the world. It is fitting that the Centennial celebration is opening on this international theme.

Farm problems are common to all nations. The United States is no exception, as Secretary Freeman can testify. Hunger is no respecter of national boundaries.

I have the advantage of viewing the role of agriculture in world affairs from two distinct, but not incompatible, positions.

As a representative in the Congress from one of the major agricultural States, I know the value to our farmers of foreign markets for farm products.

As a member of the Committee on Foreign Relations, I have observed the problems and tensions which arise among nations due to lack of food and fiber, and the importance of agriculture in the field of foreign affairs.

You all recognize the significance of food and fiber as a force in world politics or you would not be here today.

Historically, food has been a source of friction between the "haves" and the "have-nots."

From earliest recorded history, clans, tribes, and nations have struggled and fought with their neighbors for possession of productive crop and grazing land.

Food as a factor in world politics is no less significant today. Lack of food can drive nations to desperate acts.

In the world in which we live, with the threat of nuclear destruction hanging over us, we must comprehend the role that food can play in keeping the peace and relieving international tensions.

Agricultural trade was the source of substantial funds for the development of this Nation's embryo economy. With the coming of the steamship, export of our farm crops became even more important. As early as 1839 we exported \$80 million in agricultural commodities.

The westward expansion of our Nation was financed to a great extent by capital obtained through export of agricultural products. As late as 1897 they were 70 percent of our total exports.

Today they are about 26 percent of total exports.

American farmers have traditionally looked beyond the Nation's boundaries. The market for farm products, like the market for industrial goods, is not limited by national borders. It is as wide as the world itself.

U.S. farm products today are being shipped all over the free world—to Canada and Latin America, to Europe, to Africa and the Middle East, to South Asia and the Far East.

As markets have expanded, the value of goods sold has increased. Last year our farm exports reached a record total of nearly \$5 billion. This was equal to about one-sixth of total cash receipts from farm marketings.

The significance of our agricultural exports in the international food picture is seen by the fact that we supply one-fifth of the total volume of world agricultural exports.

Cotton, often the most important cash crop in my State of Missouri, is the biggest dollar earner of all agricultural exports. Nearly 50 percent of the 1960 crop was sold abroad.

Because the American farmer's market is worldwide, his interests are closely tied to international economics and politics.

¹ Senator J. W. Fulbright, Chairman of the Foreign Relations Committee, was scheduled as a speaker. Illness prevented his attendance.

He is affected by the outcome of tariff negotiations in Geneva under the General Agreement on Tariffs and Trade. Tariffs can decide the export fate of our farm products.

He is affected by the level of price supports established by the Common Market. Unduly high, protected Common Market agricultural prices mean reduced sale of U.S. commodities.

He is affected by droughts, floods, and other natural calamities. Nearly every part of the world is periodically afflicted by these natural disasters. They cut crop production, and thereby increase demand for U.S. food and fiber.

The Shadow of Hunger and Famine

Our world faces a tragic paradox. While relatively few countries are burdened with the problem of agricultural surpluses, a far greater number live under the shadow of hunger and famine.

These contrasts in food resources have been summarized by the Department of Agriculture as follows:

Diets are nutritionally adequate in the 30 industrialized nations in the temperate northern area, which accounts for one-third of mankind—more than 900 million people. Their production of food and things they can trade for food assures their food supply; now, and for the foreseeable future.

For most of the 70 less developed countries in the semitropical southern area, diets are nutritionally inadequate, with shortages in proteins, fats, and calories. These countries contain over 1.9 billion people. In most of them, population is expanding rapidly, malnutrition is widespread and persistent; and there is no likelihood that the food problem soon will be solved.

The industrialized countries of the free world cannot afford, from either a political or humanitarian point of view, to let widespread food shortages persist in the less developed countries.

These countries, most of them still politically unstable and uncertain, are impatient with the rate of their economic development; and are seeking the capital and technical assistance needed to help them create jobs and purchasing power. They are impatient with the shortage of teachers and schools, of doctors and hospitals. Above all they are impatient at the lack of the fundamentals, especially food and housing.

Hungry and destitute people are seldom rational—about politics or anything else. Hunger breeds discontent and this works against establishment of a sound and stable society.

The United States has been using its great agricultural productive capacity to help meet the needs of the less developed countries.

Through the food-for-peace program, we are supplementing the agricultural resources of over 100 countries, with a combined population of more than 1.3 billion.

Food-for-peace exports in 1961 had a value of \$1.5 billion, out of the total \$5 billion for agricultural exports.

Since 1954, when the basic authority for this program was enacted, food-for-peace shipments have amounted to approximately \$10 billion out of total U.S. farm exports of about \$30 billion—one-third of our entire agricultural exports.

Food for Peace is performing two functions. Its primary purpose is to combat hunger by the use of agricultural commodities which, because of our productive capacity, we have in abundance.

But it is also promoting economic development, which promises long-range benefits for the recipient countries, as well as for the rest of the free world.

It also furthers understanding of the United States—an awareness that our country wants to help others, because, using President Kennedy's phrase, "it is right."

Not a Permanent Solution

Sound as it may be, however, the food-for-peace program is not a permanent solution to the problem of world food imbalances. It is unsound, both morally and economically, to place part of the world on a permanent dole.

The food-for-peace program has been an important means of meeting a special situation. It may continue to be needed for some years; but it is a palliative rather than a cure.

If the serious food imbalances now existing in the world are to be corrected, the countries that are not producing sufficient food for their needs must develop their own agricultural systems, or export other products for the currencies which will purchase their needed food and fiber. These countries must either step up their output through increased productivity of agriculture, or industrialize to the point where they can purchase their needs.

We hope that one day they will become "genuine customers" for the farm products which we can produce more efficiently than they.

Our domestic development programs have always been geared to the creation of purchasing power and economic independence. This was the end result of the Marshall plan in Western Europe, and we trust it will be the result of the Alliance for Progress and our other assistance programs.

Today over 1,200 U.S. agricultural specialists are assisting and training foreign agricultural leaders, scientists, and technicians in over 50 countries. Thousands of foreign agriculturalists are coming to the United States, to find out why our farmers are so efficient.

Not only does this association provide for sharing of the skills necessary to develop their agricultural systems. It is also an important means for furthering international understanding and good will.

Through these technical assistance programs, U.S. agriculture exerts a strong and favorable influence on international relations. In the past

100 years we have built up a vast reservoir of agricultural know-how. When we share our knowledge with other countries, we can help them develop the full potential of their resources and create a better life for their peoples.

In addition, our agriculture has considerable influence on the economies of the "have" countries. For example, we are a reliable source of supply for commodities such as cotton and soybeans, which are not produced in substantial volume in Western Europe or Japan. By exporting to countries short of these commodities we raise their standard of living as well as our own.

The developed countries have a direct stake in helping us attain a satisfactory balance in our international payments.

The United States is spending large sums for the defense of the free world. Our agricultural exports to the economically developed countries, especially Western Europe, help provide the resources which enable us to maintain their security, and also the economic stability of the free world. Obviously, without these exports we could not maintain indefinitely armies in Europe and Asia.

Our best cash customers for farm products are Canada, Japan, the Common Market countries, the United Kingdom, and the other Western European countries.

But we are also selling substantial quantities for cash to many other countries, including Mexico, Venezuela, Australia, and New Zealand.

In 1961 we sold these cash buyers farm products valued at \$3.5 billion.

International markets are now recognized as a partial solution to our problem of overproduction; and we are becoming increasingly concerned with our ability to compete for them. Although our agricultural export trade has been important since tobacco was first grown in the colonies, all too often we have taken a passive approach to exports. If foreign countries needed our products, and we had surpluses on hand, we exported. Too often we left the initiative to the buyer.

I have a feeling that in following that policy we abandoned a good many markets to countries which took the initiative as sellers.

Exports Need Promotion

The need for a positive and aggressive program to promote exports is now fully recognized. We are making active, intelligent efforts to sell; and we are setting new export records. We have found that America is well able to compete in world markets on many farm products. Only on a few items are our exports in some degree subsidized.

We are paying increased attention to quality. We can and do produce high-quality products, and it is essential that we maintain this quality.

In spite of our success in recent years, there is cause for concern as regards the future. Foreign trade barriers erected by a great many of the

economically developed countries of the world do not give our products a fair chance to compete. Barriers being erected by the European economic community are of particular concern to us.

The Common Market area is a densely populated, highly developed industrial complex. As a group, it is the world's leading importer of agriculture commodities.

In 1960, the countries making up the Common Market bought \$1.1 billion of U.S. farm products. It is imperative that these great industrial countries pursue trade policies which will expand, and not contract, international trade.

The United States has negotiated fixed tariffs with the Common Market on a substantial part of our agricultural trade, some \$700 million worth. On some items such as cotton, soybeans, and certain fruit and vegetable products, we have been able to obtain reasonably favorable fixed tariffs. On these items we know where we stand, and we hope to expand their export.

For another group of items, principally grains and certain livestock products, including poultry, the Common Market is moving toward a variable levy system. This means that its import fees can be adjusted, upward or downward as necessary, to protect domestic producers.

The items in this group constitute about \$400 million worth of our agricultural exports to the Common Market. We have been trying to get assurance that we will be granted access to this market on a reasonable basis, and although we have not yet received that assurance, the way is still open for further negotiations. Of course we are hopeful that we and our European Allies can find a satisfactory solution to this vital problem.

Poultry is a prime example of the problems we face in negotiating with the Common Market. The recently established Common Market policy on poultry would raise the tariff on poultry exported to West Germany, by far the largest importer, from about 6 cents a pound to an estimated 12 cents or 13 cents a pound. Such an increase will obviously encourage uneconomic Common Market production, and keep our poultry at a permanent disadvantage.

I am disappointed by this move toward protectionism exhibited by the Common Market. The United States in large measure financed the economic rehabilitation of Western Europe. We encouraged the development of the Common Market because it represents urgently needed economic, and ultimately, we hope, political unity for that area.

U.S. support of the Common Market, however, has been predicated on the theory that trade policies of the Market would encourage trade expansion across the board, as well as common political and security policies.

The proposed variable levy proposal departs drastically from the freer trade spirit of the general agreement on tariffs and trade to which the

Common Market and the United States have subscribed in the past.

An immediate problem in our negotiations with the Common Market is the inadequacy of the existing Trade Agreements Act which expires on June 30.

New Legislation Proposed

The President proposes to replace it with the Trade Expansion Act of 1962. The new legislation would give us flexibility and greater strength at the bargaining table. Our negotiators can then offer the inducement of deeper and broader tariff cuts than is currently possible, with the proviso that U.S. concessions would be fully matched by reductions in trade barriers on the part of the negotiating countries.

Our trade problems with the Common Market will not be solved without this authority. It is imperative, however, that any agreement with the Common Market, or an individual country, provides assurances that reasonable terms of access will be provided for U.S. farm products. I would not favor any kind of package arrangement which helps one segment of our economy, at the expense of another.

The concern on the part of the Common Market nations for the interests of their farmers is understandable. But Europe also has many nonfarmers—people who man the area's rapidly expanding industries.

Europe's high-priced, relatively inefficient agricultural system should not be protected at the expense of her total economic development. A fair measure of the relative efficiency of U.S. farmers can be made by an examination of the expenditures made for food here and in Europe.

Food expenditures as a percentage of total private expenditures ranged in 1960 from a low of 26 percent in Denmark, to a high of 43 percent in Italy.

For the United Kingdom the figure was 30 percent and for France 32 percent.

In the United States our people in 1960 spent only 22 percent of their private outlays for food.

I suggest Government agencies find a way to disseminate within the Common Market and Western Europe generally America's views on the meaning and advantages of liberal trade. Commercial groups, especially those cooperating with the Government in market development work, can play a very real part in this public relations effort.

The development of a sound case so as to influence public opinion in the Common Market on the merits of lessening trade restrictions on agricultural commodities would most certainly be mutually beneficial.

The Common Market maintains an information office in the Nation's Capital, dedicated to the job of presenting their story to the American people. A mutual exchange of information between peoples, rather than between diplomatic missions and

negotiating teams, would help to form closer ties between the Common Market and the United States.

If we can work out a closely working partnership between the European Economic Community and the United States, we will increase enormously the strength and resources of the entire free world.

The ultimate result of so great an increase in Western strength may be the break in the cold war stalemate that has, thus far, eluded us.

U.S. agriculture is a world influence by its example and its success, and we can be justly proud of our achievements. The American farmer is one of the strongest pillars of our economic system.

The ingenuity of our farmers consistently confounds the best plans of our Government farm experts. The trouble in some crops is that our farmers are too resourceful, and manage to produce more on less land whenever they are confronted with production controls.

Agriculture—A Revealing Contrast

The most revealing contrast between our economic system, and that of the Russians, is seen in agriculture.

It has been said that the Communists are poor farmers because Karl Marx was a city boy. In any case, the performance of the Communists is very, very poor from any angle of comparison in the field of agriculture. We produce 60 percent more food than Russia, which has a landmass 2½ times ours and 40 percent more cropland.

Forty percent of the Russian labor force is employed in agriculture, compared to 8 percent in the United States.

The U.S. worker spends about 20 percent of his take-home pay for food, compared with 50 to 60 percent for the average Russian worker.

We know that Red China, following several successive crop failures, has had to change drastically the course of her social and economic development; and Premier Khrushchev, by his own statements, has left little doubt about the shortcomings of Soviet agriculture.

The inherent weaknesses of a totalitarian system of government are well illustrated by performances in agriculture. Under both the Russian and Red Chinese agricultural systems the individual has no incentive to produce. By their emphasis on collective and state farms, they have retreated to a feudalistic approach, which the Western world discarded centuries ago.

They fail to recognize that man is not merely a cog on a wheel turned by the State, and that individual initiative, stimulated by incentives of personal advantage, are basic to man's achieving his full productive potential.

The Communists are seriously embarrassed by food shortages. The less-developed countries that are trying so hard to improve their agriculture

can make comparisons—they recognize efficient and inefficient agriculture when they see it.

The Reds have what has been called by horticulturists a “gray thumb.” By way of contrast, the United States has the biggest “green thumb” in world history.

We feed and clothe 185 million people, ship a huge volume of farm products to other countries, and still end up with surpluses. Such a contrast must surely impress the less-developed nations.

We in America have justification for pride in our ability to produce food and fiber. The fertile soil of our country, in the hands of our efficient and ingenious farmers, has created a productive ca-

capacity which is, and will continue to be, an effective ingredient of our foreign policy.

Much has been accomplished to relieve hunger and privation around the world through use of our agricultural abundance, and continuous efforts are being made to improve the effectiveness of this foreign policy instrument.

American agriculture has set an example which, if followed and adapted to the peculiar requirements of the less-developed nations, will be a potent force for achieving the age-old goal of eliminating hunger from the world. This, in turn, will be no small contribution to the achievement of what we all hope for more than anything else—permanent world peace.

Agricultural Abundance: Instrument for Peace

George McGovern

*Special Assistant to the President and
Director, Food for Peace*

HISTORY HAS a curious way of clustering important events in a single year. Certain dates are familiar to every student because they provide a focal point for a series of historic developments. Such a year was 1862.

That year marked the Civil War battles of Shiloh, Antietam, and Fort Henry. But while these battles provided the biggest headlines over a hundred years ago, they do not represent the most enduring monuments of that year of crisis. For 1862 marked the dawn of a new era in agriculture.

It was the birthday of the land-grant college, the Homestead Act, and the U.S. Department of Agriculture. Taken together, these three institutions have helped the American farmer establish the most remarkable food production system in all world history.

The advancing American frontier and the resettlement of the West were made possible in great part by the Homestead Act. This far-sighted legislation provided the economic basis of political democracy in our frontier society. It stemmed from the Jeffersonian conviction that “the small landowners are the most precious part of the State.” It provided a Federal charter for family farm ownership and operation.

Likewise, the American farmer has been mightily assisted by the Morrill Act which created the land-grant college system. A recent study has concluded that two-thirds of the increase in our entire industrial and agricultural output of the past 150 years has been the result of research and education. The science of agriculture has been established in the United States in our land-grant colleges. No one factor more clearly explains the amazing productivity of our farms.

So, today, we salute our farmers for their productive skill. We salute the Homestead Act for

establishing the principle of the individual family-type farm. We salute our land-grant colleges. Especially do we honor the Department of Agriculture for 100 years of service to the people of the United States and the world.

The century-long success story of American agriculture is one of the most spectacular achievements in our national history. No country in the world produces so much food so cheaply and so efficiently as does the United States. With only 8 percent of our population working the soil, we have multiplied our food-producing capacity many times over. Nowhere in the world can the consumer buy his food with so small a percentage of his income.

A Crisis in Abundance

Yet, because of the amazing success of American agriculture, we are faced with what Secretary Freeman has described as “a crisis in abundance.” Although we live in a world of hunger, our warehouses are bulging. In spite of severe acreage restrictions, vast Government stocks are still with us.

Considerable progress has been made by the Department of Agriculture under Secretary Freeman in bringing U.S. production more into line with our actual food needs. Nevertheless, a recently published report by the National Planning Association opens with these words:

The Commodity Credit Corporation holds about \$8 billion worth of farm surpluses purchased in price support operations. Storage costs alone have been running about \$1 million a day.

The author adds:

We are not apt to do away with agricultural surpluses in the next few years. Even if farmers make sizable cuts in production, it seems almost certain

that for the foreseeable future total agricultural production will be more than regular markets will absorb at reasonable prices.

But the rest of the globe presents quite a different picture. In the Soviet Union, for example, the labor of half the population is required to feed the other half. In other Communist countries, food production is even less satisfactory. Indeed, well over half of the inhabitants of the globe do not yet know freedom from hunger.

Covering the 1943 famine in China's West Honan Province, Time Magazine correspondent Theodore White wrote:

My notes tell me that I am reporting only what I saw or verified; yet even to me it seems unreal: dogs eating human bodies by the roads, peasants seeking dead human flesh under the cover of darkness, endless deserted villages, beggars swarming at every city gate, babies abandoned to die on every highway. . . . Nobody knows or cares how many refugees die. . . . Of Honan's 34 millions we estimated that there have been 3 million refugees. In addition, 5 million will have died by the time the new harvest is gathered.

In that same year, nearly 20 years ago, famine struck the Bengal Province of India. No one knows how many Indians died of starvation; the estimates range from 1 to 3 million. An acquaintance of mine who was there at the time tells of "the constant rumble of trucks piled high with human bodies bound for mass graves at the edge of Calcutta."

Today we may draw uneasy consolation from the knowledge that nowhere are conditions as bad as those described two decades ago. But mass hunger is still with us. Progress against this ancient enemy of mankind has not kept pace with the march of technology.

Recently we shared the awe of astronaut John Glenn who viewed the glories of four sunsets from his capsule in outer space. But the world which Colonel Glenn left behind for those few hours is a world where two-thirds of the inhabitants are still tilling the soil with crude implements and primitive techniques that have been little changed in the past 3,000 years. Most of these people are suffering from malnutrition and disease. Millions of others in the city slums from Lima to Hong Kong are no better off.

Companions of Malnutrition

It is thus still the fate of most of the inhabitants of the earth to know the pain of hunger, to see their children wither and die of disease brought on or complicated by malnutrition, to know the listlessness of body, the dullness of mind, and the weariness of spirit that are the companions of malnutrition.

This paradox of plenty in the midst of hunger prompted Congress to enact in 1954 one of the most imaginative laws ever placed on the U.S. statute books.

Public Law 480, passed with broad bipartisan support, made American surplus food available

to friendly countries who were unable to meet their needs through traditional commercial arrangements.

Since its passage in the summer of 1954, food and fiber valued at \$15 billion have moved to more than 100 countries and territories.

The largest portion of the food agreements has been sales for nonconvertible foreign currency. We in turn have loaned or granted most of the currency to the contracting governments for development purposes. A modest portion of the currency has been held for certain U.S. programs, such as market development, educational exchange, or private business loans.

Under other sections of the law, food has been granted to meet famine conditions, to feed needy families or refugees, to encourage economic development projects, and to assist school lunch programs. In some cases, these programs are conducted by our Government directly with the receiving government. In other cases, we have made use of the splendid services of private voluntary agencies such as CARE, Church World Service, Catholic Relief Services, Lutheran World Relief, the Joint Jewish Distribution Committee, the American Friends Service Committee, the Mennonites, and others.

These dedicated religious and humanitarian agencies represent people-to-people assistance at its best. They literally have their arms around the world in an effort to feed the hungry and heal the sick. In 1961, nearly 3 billion pounds of U.S. food found its way to 64 million hungry people—thanks to the concern of our humanitarian agencies.

Yet, there has been an uneasy feeling in the United States that we could do more with our agricultural abundance to reduce human hunger and suffering.

Food Abundance, an Asset

President Kennedy expressed this concern on January 24, 1961, in the opening hours of his administration when he issued an historic Executive order. In that order the President said: "It is of fundamental importance that we have a national food policy directed toward using our agricultural abundance as a national asset to meet foreign policy objectives."

In an accompanying directive, Mr. Kennedy said:

American agricultural abundance offers a great opportunity for the United States to promote the interests of peace in a significant way and to play an important role in helping to provide a more adequate diet for peoples all around the world. We must make the most vigorous and constructive use possible of this opportunity. We must narrow the gap between abundance here at home and near starvation abroad. Humanity and prudence, alike, counsel a major effort on our part.

The President then established a Food for Peace office in the White House and called upon me as its first Director "to exercise affirmative leadership

and continuous supervision over the various activities in this field." He instructed me "to consider very carefully the intimate relationships between our foreign agricultural activities and other aspects of our foreign assistance program."

This far-reaching Executive order has given a dynamic new dimension to American food reserves. It has done much to replace the negative concept of "surplus disposal" with a positive view of U.S. agricultural abundance as a precious national asset. It has given the American farmer a vital stake in foreign policy. It has focused worldwide attention on the achievements of American agriculture in a world of food shortages. It has strengthened the political and moral position of the United States in international affairs.

There is, of course, a double thrust behind Food for Peace. It is first of all clearly in the self-interest of the American people to reduce costly storages, to protect our farm economy from price-depressing surpluses, to stimulate our shipping industry by massive food shipments, and to develop long-range commercial markets. Food for Peace does all of these things.

But the other thrust behind Food for Peace stems from the philosophy of the scriptural admonition to "feed the hungry." No one can doubt the genuine, humanitarian desire of the American people to see our food reserves shared with hungry men and women, boys and girls the world around.

Thus, the 45 billion pounds of U.S. food and fiber which we programed in 1961 for overseas use can be viewed properly as both a valuable asset to American agriculture and a tremendous contribution to the well-being of mankind!

Food—A Force for Peace and Freedom

We now see the Food for Peace program not only as an important market development activity, but also as an instrument of international health and nutrition, a tool of economic and social development, and a vital force for peace and freedom.

It has become an indispensable ingredient in U.S. foreign assistance. In some countries, it is the major component of American aid. Of the \$4 billion in U.S. technical, financial, and food aid that has gone to India in the last decade, 62 percent has been food. In Egypt, Food for Peace has comprised 75 percent of our aid in recent years, and is currently 89 percent of our assistance to that crucial country.

The program is manifesting itself in several ways:

1. It is definitely raising nutritional levels.
2. It is curbing inflation—especially in areas of economic development which would otherwise suffer from inflationary pressures on their scarce food supplies.
3. It preserves the foreign exchange of developing countries for other necessary imports.

4. It is encouraging economic development by giving new energy to workers and students, and by the indirect results mentioned above. It permits a greater degree of industrialization than would be possible if the country were required to produce all of its food.
5. Perhaps most important, food assistance, unlike some other forms of aid, reaches broad masses of people with an immediate impact. People may find it difficult to appreciate the impact of such U.S. aid as budget support or development loans for industry. Indeed, it may be a long time before the peasants, the villagers, or the city slum dwellers feel any benefit from these aid programs. But a piece of bread or a glass of milk is understood and appreciated. This is aid that is immediate, concrete, and centered on the neediest elements in the country. It narrows, rather than widens, the gap between the favored few and the needy masses.

There were two especially important breakthroughs which occurred on the Food for Peace front during the past 16 months which hold exciting future prospects. The first of these is the use of food to pay the wages of workers engaged in building schools, roads, clinics, and rural improvements.

Today in 10 countries, American cereals and other foods are financing part of the wages of workers employed on valuable public works projects. Wheat from Kansas and the Dakotas and corn from across the Midwest are being converted into classrooms, roadways, and better communities abroad.

A second challenging breakthrough is a greatly expanded overseas school lunch program. The most precious asset of any nation is its children. Their health and education are the twin foundations of social growth. What foreign assistance could be more rewarding than a nutritious mid-day meal for hungry boys and girls.

Such programs not only give new physical energy and health to the children; they result in sharply improved school attendance and academic performance. In Peru, for example, a pilot school lunch agreement signed with Prime Minister Beltran a year ago has already resulted in a 40-percent increase in school attendance. Within 4 years we will be feeding a million undernourished Peruvian schoolchildren.

A Good Idea Exported

The editors of Parade Magazine tell the heart-warming story of how an American-assisted school lunch program brought new strength to Japanese children, opened up a vast new commercial market for U.S. farm products in Japan, and is now being operated entirely by the Japanese:

One of the first moves General MacArthur made during our occupation of Japan was to start a school-

lunch program. For the next decade every school-child in Japan got at least one good meal a day and learned to eat bread and drink milk. An entire generation of Japanese has been influenced by this change in diet. The school lunches are now a fixture of life in Japan, and that country has become the leading customer in the world of the American farmer.

What's happened to the Japanese physique with the new diet? Boys of 15 are on the average 3 inches taller than their grandfathers were at the same age; girls are 3 inches taller than their grandmothers, and their bust-lines are 1 inch larger, to say nothing of their feet and legs. Tokyo school authorities also report that today's kids are too big for the desks their parents used as schoolchildren.

Today U.S. Food for Peace-assisted school lunch programs are reaching 34 million children in 80 countries of the world. But there are 700 million children around the world who need such a program. Is Food for Peace equal to that challenge? Will the local governments do their part in establishing a school lunch for every needy child? I hope that some day in the not too distant future we can answer "Yes" to both questions.

Many years ago, Prime Minister Nehru observed: "You cannot talk of God to a starving person; you must give him food." It is equally certain that you cannot talk effectively of science and history and literature to listless, undernourished children.

I know that President Kennedy and the American people stand ready to share our resources so that every child can have food in his stomach, strength in his arms, hope in his heart, and light in his eyes.

Dr. Sen, the distinguished Director General of the U.N. Food and Agriculture Organization, said in launching the worldwide Freedom From Hunger campaign:

One man's hunger and want is every man's hunger and want. One man's freedom from hunger and want is neither a true nor a secure freedom until all men are free from hunger and want.

Food for Peace works toward that end.

Agriculture—A Moving Force in Economic Growth

Oris V. Wells

*Assistant Director General, Economics Department
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I ASK your pardon for beginning on a purely personal note.

But this is one of those rare occasions when my official responsibilities, my personal inclinations, and the desires of the Program Committee all coincide, most happily and most precisely.

Officially, I bring to you, Secretary Freeman and to the U.S. Department of Agriculture whose Centennial anniversary we are here to celebrate, the congratulations of Dr. B. R. Sen, Director General of the Food and Agriculture Organization of the United Nations, on your great achievements to date, as well as best wishes for the future.

Personally, it is difficult for me to say how much I appreciate the chance to attend and participate in this Centennial celebration, not only because of a close, long-continued acquaintance with the USDA and the necessary rarity of such occasions as this, but also because of the essential importance of the subjects to which this World Food Forum is addressed.

Finally, as to the Program Committee, I am in full agreement with their desire that this talk should focus attention on agriculture as a main source of growth or economic development.

We need not immediately endeavor to define "economic development" beyond saying that it is a term now generally used to indicate the kind of continuing economic progress, both in aggregate national output and increasing per capita levels of living, which is today a major aim of every country in the world.

What is more important for our purpose than any precise, overly sophisticated definition of economic development is an understanding of two simple ideas which underlie the current worldwide drive just referred to. These are:

1. The mere absence of war is no longer a sufficient condition for the kind of peace in which we are all interested. That is, the positive concept of peace also includes the idea of a concerted attack on the interrelated complex of those great enduring problems which impede human progress: illiteracy, poverty, and hunger.

2. Adequate, efficiently produced supplies of food and agricultural raw materials are an essential base or precondition for economic growth or development, regardless of the country or particular part of the world in which we may be interested.

These, Mr. Secretary, or so it seems to me, are basic ideas underlying both the Food for Peace program of the U.S. Government and the Freedom From Hunger campaign of the Food and Agriculture Organization.

The positive concept of peace which underlies these two complementary programs or campaigns is also of course basic to the current United Nations resolution, sponsored by the United States among other countries, calling for a series of action which will make the next 10 years a "Decade for Development."

Many people, however, are still unfamiliar with the second idea—that is, that no satisfactory solu-

tion to the problem of economic growth in developing countries is possible without or until an adequate supply of food at reasonable prices is assured by one means or another, usually in the largest part by developing agriculture within the particular country itself. In fact, the role of agriculture in economic growth is a matter which has been and still is far too much and too often neglected, despite the rapidly rising volume of attention, both in terms of theory and of action, which is currently being given to the overall or aggregate process of economic development.

PERHAPS YOU will permit a brief digression to speculate on this relative neglect of the role of agriculture and food. Why has so much attention been focused on industrialization, so little on agriculture?

There are several reasons, partly inherent, I think, in the basic experiences of the world's two greatest industrial nations, the United Kingdom and the United States. Basically, the agricultural and food problems of the United Kingdom were solved outside the island itself, by agricultural progress in the United States, in Argentina, Canada, Australia, New Zealand, and elsewhere. A free trade policy allowed the first great leader of the industrial revolution to maintain adequate supplies of food while almost its whole labor force was shifted from agricultural to industrial employment. The problems with which the British were concerned during the 19th century had to do chiefly with finance, industry, and trade. Agriculture was a secondary interest.

The United States, however, has produced not only most of its own food but also large quantities of cotton, tobacco, and food for export. In this case, however, the answers were in some ways too easy, due to the abundance of fertile new land, the driving energy of pioneer people, and a remarkable record of inventive genius, which mechanized American agriculture as industry itself advanced. Agriculture was taken for granted or, in more recent years, was looked upon as a source of surplus troubles rather than as a main driving force in economic development.

The examples of the United Kingdom and the United States, with emphasis on their long records of industrialization and rising standards of living, have been looked to by other nations. Then too, some development economists have felt that prices for agricultural exports are marginal prices, determined in such a fashion as to mean that the gains from improvements in agricultural efficiency, with their usual consequent increases in production, are largely transferred to foreign purchasers. Some others have felt that the institutional barriers to change, or to what we now call agrarian reform, were so great that they could best be broken by a rapid drawing of the labor force into industrial nonfarm employment.

Finally, we have increasingly immersed ourselves in "national accounting," a process which defines the end product of our economic endeavors in terms of "national income" and "gross national product" and indicates the contribution of each major sector of these final aggregate calculations. So we now accept as axiomatic the proposition that agricultural population declines and agriculture's "contribution" to the national income or gross national product rapidly falls away as a country's economy develops.

All of you are acquainted with the relevant American statistics. A century ago, for example, agriculture's contribution to the gross national product must have been on the order of 50 percent, with the rural population, which at that time was almost completely farm-oriented, accounting for 80 percent of total U.S. population. A half century ago, at a time when farm population reached its peak in absolute numbers, farm people accounted for only 35 percent of the gross national product. Today, your farm population is about 10 percent of the total and agriculture is credited with contributing not more than 5 percent of gross national product.

Some Estimates Inadequate

Please understand that I am not endeavoring to criticize national income or gross product estimates. Quite the contrary. They are most useful and necessary statistics—statistics which tell us what is being produced, how income is distributed as between different sectors of the economy, and the changes which are taking place over time. But they are not in themselves a causal analysis or sufficient measure of the role and importance of each sector, and of agriculture especially, in the creation of the national product. In the case of the United States, for example, I suggest that an analysis of the problems which would be raised by the absence of a successful agriculture within the national economy would well illustrate this point.

Or looked at in another way, from 1900 to 1960 agriculture is credited with having "contributed" 1.8 percent, or \$4 billion to the overall \$222 billion increase, measured in 1929 dollars, in U.S. gross national product. But suppose there had been no increase in agricultural productivity over the period with, say, 40 percent of the Nation's population, or 72 million people still on farms in 1960. Under such conditions, would anyone seriously argue that the current gross national product and American standards of living would have only been lowered by something less than a scant 2 percent?

Fortunately, this neglect of the role of agriculture is beginning to be remedied. The matter is being more and more discussed in both academic and operating circles, chiefly because of its practical importance in the underdeveloped or developing areas of the world.

Rostow, in his now classic analysis of the stages of economic growth, quite clearly says, and I quote:

... revolutionary changes in agricultural productivity are an essential condition for successful take-off; for modernization of a society increases radically its bill for agricultural products. . . . There are, in fact, three distinct major roles agriculture must play in the transitional process between a traditional society and a successful take-off. . . . [That is,] Agriculture must supply expanded food, expanded markets, and an expanded supply of loanable funds to the modern sector.

Meanwhile, the American Economic Review has recently published a leading article on the subject by Messrs. Johnston and Mellor—an article to which I should here acknowledge my indebtedness. I also know, Mr. Secretary, that this subject is now under intensive study within the Department; that it will in one way or another occupy much of our time at this World Food Forum; and that it will be one of the central themes at the World Food Congress which, as one of the high points of the Freedom From Hunger campaign, is scheduled for Washington, D.C., in June 1963, thanks to the generous offer of the United States to serve as host government.

I NOW WANT to examine, at least in outline form, the relations between agriculture and economic growth in the United States over the one hundred years, 1862–1962.

In examining the U.S. record, however, we should keep in mind the contributions which current development theory would expect from agricultural progress, or more precisely, the results which are expected to flow from increasing agricultural efficiency and output. For most developing countries, these are:

First, agriculture is expected to supply the food and agricultural raw materials needed to keep pace both with increasing population and, as incomes increase, an increasing per capita demand;

Second, agriculture is expected, as agricultural efficiency increases, to release large blocks of workers for industrial and other nonfarm employment;

Third, agriculture is expected to supply substantial amounts of foreign exchange and domestic revenue or capital for financing necessary governmental activities, servicing of foreign debt, and actual nonfarm investment;

Fourth, agriculture is expected to supply a growing market or base for the manufacturing and service industries, both in terms of a rising demand for production requisites—machinery, fertilizer, and the associated transport, processing, and merchandising services—and in terms of increased per capita purchases of consumer goods among farm people; and

Fifth, agriculture is increasingly, even in developed countries, expected to be sufficiently productive to supply food and the natural raw materials at such prices as to substantially assist in controlling inflation. This fifth point is per-

haps implied in point one. Still, it seems worth separate mention.

Obviously as an economy develops, agriculture's contributions under points 2 and 3 especially and to some extent under point 4 will progressively diminish in importance. But all five points were applicable to the United States of a century ago as well as to most of the developing countries of today's world—countries in which, "typically, some 40 to 60 percent of the national income is produced in agriculture and from 50 to 80 percent of the population" is farm employed.

This discussion is centered around American agriculture and its performance over the century since President Lincoln signed the bill creating the U.S. Department of Agriculture on May 15, 1862. But we should also of course be aware of the conditions which preceded the now famous agricultural actions of the U.S. Congress in 1862.

According to Rostow, the United States had reached the "takeoff" stage some years prior to 1862. American agriculture was feeding the population very well, while at the same time cotton and tobacco exports were contributing a relatively large amount of much needed foreign exchange. Manufacturing was well established in the Northeast and the Nation was well started on the creation of a modern railway system, and among other actions, the Congress also provided "in 1862 for the construction of the Union Pacific through to the west coast.

As far as the agricultural technology was concerned, there was a substantial backlog of mechanical inventions which were just beginning to be generally adopted. Agricultural societies offered leading farmers a chance to discuss possible ways of improving agricultural productivity as well as the other farm problems of the time, while many of the crucial problems in the new areas were being worked out by the hard process of trial and error. Farming had reached the edge of the Great Plains, but there were still large areas of productive new land available for settlement.

100 Years Ago

This then was the setting in 1862: a well-developed agriculture in the middle of the first American "agricultural revolution," but beset with substantial marketing difficulties, especially in the newly settled Midwest. Some 600-odd farm societies were actively discussing farm problems, with many of them agitating for agrarian reform, a course to which the new President was not only committed but found politically necessary as he faced the difficulties of holding together the industrial East and agrarian West.

So in 1862, the Congress created a Federal department of agriculture, provided for a system of land-grant colleges, and passed the Homestead Act.

These actions were in a way an extension of existing trends. The new department was chiefly

staffed from the old agricultural division of the Patent Office, the new colleges of agriculture were in effect an extension of the interests of the numerous agricultural societies, and even the Homestead Act simply represented the culmination of policy trend which traced back to the Northwest Ordinances of 1785 and 1787.

But a series of decisions had been taken. The first "client-oriented" Federal department had been created; provision had been made for a series of "people's colleges" devoted to the agricultural and mechanical arts; and the Homestead Act, whatever its critics may now think of it, was clearly designed to encourage the development of family-size, owner-operated farms. Fortunately these were not isolated or one-time decisions. Instead, the underlying concepts were not only parts of an interlocked whole: they were also so well chosen as to provide the continuing framework within which American agricultural policy was to develop over the years ahead.

Farm prices, as well as other U.S. prices, rose during the War Between the States while large numbers of able-bodied men were drawn off the farms in both the North and South. This set the stage for the further adoption of new machines which had been developed during the preceding three decades, and agriculture, especially in the midwestern areas we now call the Corn Belt, made very rapid progress indeed.

Then came the aftermath of the Civil War.

After the Civil War, wholesale prices in the United States, including farm prices, entered upon a long decline which merged after 1873 with a worldwide decline that continued until about 1896. In fact, there were recurring periods in the 1870's, the 1880's, and the 1890's which were most often referred to as "hard times" among farmers and this was true for the Nation as a whole during the Great Depression of 1873.

Agriculture, a Dominant Force

Agriculture was a dominant force in pulling the American economy out of the difficulties of the 1870's and it was also a strong sustaining force in the 1880's and the 1890's.

Wheat production increased from about 250 million bushels in 1870-73 to 500 million bushels, or just double the predepression level in 1879-80. Wheat exports soared from 50 million bushels in 1870-72 to almost 175 million in 1878-80. The southern farming structure was reorganized, cotton production reached its prewar level in 1875, and exports moved from 2.4 million running bales in 1870-72 to 3.8 million in 1878-80. As a result of these and related developments, the value of the U.S. exports increased, business revived, and the Treasury was able to resume specie payments (or if you prefer, a hard-money policy) on January 1, 1879.

Progress continued. Corn acreage increased 50 percent and corn production by 500 million bush-

els; the Corn Belt became the main feed-grain and meat-animal producing area; and Chicago, the Nation's packing center. The new department was given its first regulatory authority with respect to animal disease; Theobald Smith and his associates isolated the carrier of the cattle tick fever; the Congress provided for the State experiment stations, at one of which Atwater began his work on nutrition which was soon to be transferred to the new department. Agriculture moved into the Great Plains, the great cattle ranching boom spread over the arid and semiarid West; and in his 1890 report, the Director of the Census indicated that "there can hardly be said to be a frontier line"—the days of cheap, free land had come to an end.

Some new summary statistics (recently supplied to me by courtesy of the USDA) may help us understand the importance of American agriculture as a general economic force during the closing decades of the 19th century. Agriculture accounted for almost 80 percent of the value of all American exports in the 1870's, over 75 percent in the 1880's, and 70 percent in the 1890's. Agriculture's "contribution" to the increase in U.S. gross national product was about 27 percent in the 1870's, declining as prosperity revived to 12 percent in the 1880's and then increasing to 16.5 percent in the 1890's. Rural population continued to increase in absolute numbers during these three decades, but steadily fell as a percent of the U.S. total.

There are two features of this period during which agriculture helped move the American economy into the sustained economic development stage which we should note. First, although there was a long decline in farm prices, other wholesale prices were equally flexible. And second, the increasing values of American farm exports during this period was being sold into an elastic and expanding western European market. The increasing inflexibility of nonagricultural prices over the last four decades is of course a chief reason underlying current demands for farm price support, while the problems of maintaining relatively free access to export markets is today a matter of keenest interest to every agricultural exporting nation, whether developed or underdeveloped.

At the Turn of the Century

The early 1900's from 1900 to 1914, has always seemed to me both a curious and an interesting period. The frontier had disappeared. The new technology based on the inventions centering around 1830-50 and the following improvements had largely worked itself out. Crop yields had been stable for some 25 to 35 years, farm prices were increasing, and the "hard times" which had plagued farm people in the preceding decades had been considerably ameliorated.

Statistically, agricultural productivity per farmworker remained constant during these years—that is, the average number of persons supplied farm products per farmworker, which had gradually increased from about four persons per worker in 1850 to seven persons in 1900, was still seven in 1910. Agriculture's "contribution" to the gross national product was also the same in 1910 as in 1900, and for the first time for which statistical estimates are available, American agriculture was credited with no contribution to the increase in the Nation's gross national product.

On the surface, agriculture's position at this time approximated the "static equilibrium" concept of the classic economists. But this was more a seeming than a real equilibrium. Farm people were far from satisfied with rural conditions as evidenced by the report of President Roosevelt's Country Life Commission of 1908. Seaman A. Knapp and the General Education Board were in the process of demonstrating the value of a farm advisory service in the depressed agricultural areas of the South. Conservation was becoming a matter of concern. The State experiment stations and the Department were well along in the process of developing the research and extension approaches which, along with the tractor, were to underwrite the new techniques that were not to come into full use until World War II.

Agricultural economics was in the air. And farm leaders were asking for marketing reform, including an adequate farm credit system, for USDA grading and classing of farm commodities, and for the right to work together in farm co-operatives—all of which were to lead to congressional action over the two decades, 1902–22.

Surely, there is not much reason for me to review American agricultural developments from World War I forward in any detail. You know the essential role which food played both during World Wars I and II and the reconstruction periods which followed. You are acquainted with the irreversible nature of agricultural supply curves and the farm surplus problems which arose as the war-induced demands for American products disappeared in the early 1920's and again in the 1950's.

You are also aware of the dramatic and continuing increase in agricultural productivity over the last two decades—a rise in productivity which played a leading role in World War II stabilization activities, which resulted in relatively low domestic food prices over the last decade, and which has made available the actual supplies of food which give concrete support to your Food for Peace program and the wider international discussions on "Development Through Food." Whereas one farmworker supplied enough farm products to feed 7 people at home or abroad in 1910, the comparable figure was 11 in 1940 and, I should think, about 27 for 1962.

Much Accomplished; Much To Do

Let us now check the U.S. record against the contributions which current theory suggests agriculture should make to economic growth.

First, agriculture is expected to supply the necessary food to keep pace with an increasing population and any rises in per capita demand.

American agriculture has done this.

Second, in a developing economy, agriculture is expected to release labor for nonfarm employment.

American agriculture has done this.

Third, in a developing economy, agriculture is expected to supply substantial sums of foreign exchange and domestic capital for use within the nonfarm sector.

American agriculture did do this in the earlier years of the century under review and is even today a substantial factor in this field, accounting for over \$3.5 billion of commercial exports in the fiscal year 1960–61.

Fourth, agriculture is expected to supply a growing market or base for the manufacturing and service industries.

American agriculture has done this, especially during the later years of the period under review. U.S. farmers are currently spending some \$40 billion annually for production requisites and consumer goods—a very sizable segment of the American market. And as for the forward "linkage" effect, more people in the United States are now engaged in processing, transporting, and merchandising food, farm-produced fiber, and tobacco than are engaged in agriculture itself.

Fifth, agriculture is increasingly expected, even in developed countries, to serve as an anti-inflation force.

As indicated earlier, I feel American agriculture has been extremely efficacious in this connection both at home and on many occasions abroad. America's agricultural abundance has not only been used abroad during the world food crises following World Wars I and II but, as you all know, large quantities of food are today going abroad on a concessional sale basis to the developing countries under Public Law 480—the Agricultural Trade Development and Assistance Act—as an aid to economic development.

Before leaving this analysis of the U.S. record, there is one last observation I must make.

I have centered attention upon agriculture. But we of course recognize that the real target of any economic growth plan is balanced development. As a rule, industrial development is also essential—essential to supply many of the items which most people over the world want, essential as a means of supplying employment to large numbers of underemployed rural people, and essential as a means of increasing per capita income and a country's internal market for food.

SINCE OUR frame of reference covers the world as a whole, I now want to consider two questions

relating to the food and agricultural problems of the developing nations—nations which account for about 2.2 out of the 3 billion people of the world's current population.

First: What is the size of the task which will be required if hunger and malnourishment are to be minimized or banished?

Briefly, we use the term "hungry" to refer to those who simply do not have enough calories to eat. Conservatively, some 300 to 500 million people fall in this class. By "malnourished" we mean those whose diets are unbalanced or whose general level of health and productivity would be raised by a better quality diet even though they may have enough food quantitywise. About half of the 2.2 billion people in the developing countries fall in this class. These deficiencies are found to some degree over the whole of the developing areas, but they are especially concentrated in the Far East.

Any successful attack on these food deficiencies in the less-developed areas must be closely related to agricultural improvement and general economic development. Current estimates indicate that the rate of increase in national aggregate incomes in the developing countries are on the order of about 3.5 percent per annum. Estimates of the annual growth of population for the next few years are around 2.5 percent (as compared with about 2 percent average over the last decade), which would mean a current increase of about 1 percent per annum in average per capita incomes. Meanwhile, the recent annual rate of increase in food production in the developing areas averages something less than 3 percent.

Statistical calculations made in the Food and Agriculture Organization show that in order to overcome the estimated calorie deficits and to bring some quality improvement in the diets of the less-developed countries within the next decade would require that the average rate of increase per annum in available food supplies would have to be increased by one-half—that is, from an average of 2.8 to 3 percent per annum to an average of 4 to 4.5 percent.

More specifically, our calculations suggest a target increase of 1.8 percent in per capita expenditures for food in the developing countries over the decade ahead. This would call for an increase in average per capita incomes of about 2.3 percent per annum, assuming an elasticity of demand for food in the developing countries on the order of 0.8 percent. Such an increase in per capita incomes and food expenditures would in turn mean, assuming the population increases at the rate of 2.5 percent per annum, a target for an overall or aggregate increase in national incomes on the order of 5 percent, which is I believe the average annual

rate if increase aimed at in the plans for the U.N. "Decade for Development."

All this clearly suggests that agriculture is one of the basic areas to which the less-developed countries must give major attention and that what is needed are strong, well-planned integrated programs, persistently pursued, rather than a series of short-term, piecemeal efforts. Further, the whole argument has suggested that such an integrated approach should include:

a. An appropriate ministry or department of agriculture at the national level capable of planning, formulating, and, where necessary, executing the policies and measures needed to supply the appropriate infrastructure or overall framework for agricultural progress;

b. Arrangements to encourage education, with attention not only to overcoming the general problem of illiteracy but equally to assure that those who need it also have the opportunity for education in, to use an American term, "the agricultural and mechanical arts (including home economics)," at both the secondary and college levels; and

c. Full recognition of the importance of the need for institutional change or agrarian reform, which in plain English means the development of land tenure, farm credit, internal marketing, and other arrangements designed to assure farmers of adequate incentives for increasing efficiency and farm output.

In conclusion, Mr. Secretary, what has surprised me most, as I have tried to work through this analysis of agriculture's relation to economic growth, taking into account some 16 postwar years of debate, statistics, model building, and journal mathematics—what surprises me most, Mr. Secretary, is how well the agricultural societies of the day, the Congress, and the President were able to anticipate modern development theory in the spring of 1862.

ACKNOWLEDGMENTS: There are a number of acknowledgments which need to be made. I am indebted to Messrs. J. P. Cavin and Wayne D. Rasmussen for making available to me several statistical tables and some notes dealing with agriculture's historical relation to the U.S. economy which have served as the source of a number of my statistical references. I am indebted to Messrs. A. M. Saco and E. M. Ojala of the Economic Analysis Division of the Food and Agriculture Organization for a number of most interesting discussions on the relation of agriculture to economic development, and the head of our Statistics Division, Dr. P. V. Sukhatme, for the summary calculations on current food deficits in the less-developed nations. The data and analysis relating to the depression years of the 1870's, the 1880's, and the 1890's were largely drawn from my own paper: O. V. Wells, "The Depression of 1873-79," *Journal of Farm Economics*, vol. XIX, No. 2, May 1937; and as I indicated in the text, there is a most helpful recent article: B. F. Johnston and J. W. Mellor, "The Role of Agriculture in Economic Development," *The American Economic Review*, vol. LI, No. 4, September 1961.

PANEL ONE

In analyzing the historical background for this discussion, the principal speaker draws upon the diverging viewpoints of two stalwarts of the era, Thomas Jefferson and Abraham Lincoln. As is well known, Jefferson distrusted cities and crowds; he felt that government was best served by voters who lived on the land. He once wrote, "Those who labor in the earth are God's chosen people. . . ." Lincoln, on the other hand, was not so positive for he once said, " . . . I believe there are really more attempts at flattering them [the farmers] than any others; the reason of which I cannot perceive, unless it be that they cast more votes than any other."

THE EVOLUTION OF U.S. AGRICULTURE AS RELATED TO POLITICAL THOUGHT AND ACTION

Introductory Statement

Murray D. Lincoln, Moderator

President, CARE; President, Cooperative League of the U.S.A.

I AM HAPPY to participate in this forum, because I think it is one of the most important subjects before the world today. And I've been trying to think through, in my own terms, the scope of the problems with which this panel of distinguished specialists is called together to discuss. I lay little claim to a grasp of the overall theory involved, so I have to rely on the things I have known and learned since I have been in this field.

I remember that this country was from its beginning founded on the free farmer, and that the conception of agrarian independence colored most if not all the basic concepts which we have evolved.

In my mind, these concepts found political expression in men tied close to the land. There was the farmer-politician Thomas Jefferson who wrote in large letters that "All men are created equal," and gave the family farmer, who was his ideal, the feeling of the dignity of man. Down the years came Andrew Jackson and later populism with its grassroots radicalism. George Norris, the senior La Follette, Lynn Frazier, Smith Brookhart, and Frank Walsh were practitioners in this area. And farmer-labor parties and farmer political parties came and went.

I have always been deeply impressed by the fact that our farmer political thought and action

emerged in a land that was so rich in resources. Our political thought and action evolved in the context of great spaces and rich lands. It was possible practically to develop political measures for land distribution in terms which were expressed as "40 acres and a mule," and of western homesteads as big as a section of land. I need not tell you how different is this background than that of other lands, where holdings are tiny, fragmented, or poor, or all three.

Our heritage of rich resources and much space should have been sufficient to safeguard the living of the farmer, but, as you know well, it was not. Early in my career as the first extension agent in Connecticut, I discovered this firsthand.

Nobody knew what an extension agent was supposed to do. So I asked Dr. Jarvis, who was in the Department of Agriculture, what I should do. He said, "Good Lord, I don't know. Just go down there and find out what the source of income of the farmer is and try to improve it."

One of the first farmers I was told to meet was in Stonington, Conn. It was well named before it was taken over by rich summer resort people. It was similar to my own country, in Massachusetts. It didn't look very prosperous.

As I met this big, raw-boned Yankee farmer, almost without introducing myself, I said to him, "Good Lord, man, what is your source of income in this area?"

And I have heard this story quoted later, but it actually happened. He looked at me and said, "Source of income, young man? We don't have any around here. We live on lack of expense!"

What has continued to impress me is that around the world it is still a problem that we have people living on lack of expense.

Not long after came the depression, and some of you may remember, as I do, farmers' wars against the railroads, the bankers, the fertilizer, and machinery monopolies. You may also remember milk strikes, violent resistance to foreclosure sales, farm holiday movements, marches on State capitals, and somewhere you may have heard cries of political agitators such as "Raise less corn and more hell!" Although our land was rich, in our Great Plains States there were breadlines where farm families waded knee deep in wheat.

It took political thought and political action to straighten out part of that mess. The mess brought into being not only the agrarian rebels but became the inspiration for hundreds of young people. They became the students such as you,

who have delved deep into the reasons for our failures and sought the political remedies, and are still seeking them.

Your knowledge of these ferments and upheavals in our country now stands the world in good stead. Your participation in creating the theory and outlining proposals for the actions which have given us in this country the body of legislation and regulation which characterizes present-day agriculture, equips you for the new job—that of figuring out ways to help farm peoples in other lands find solutions for their political and economic dilemmas.

We all know that they have their problems of land reform and distribution. We know that they have their problems of monopolies, moneylenders, and, indeed, of feudalism. And though their problems are in different dimensions, and solutions must emerge from their cultures and be in their terms, yet I am sure we can be of some help.

For it is certain they, like us, are members of the same worldwide fraternity of farmers. Therefore, your knowledge and your political applications can provide them—and us—with cues and clues for the development of a world where the full bullet box gives way to the full bread box.

The Evolution of U.S. Agriculture as Related to Political Thought and Action

John M. Brewster

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FOR ALL WHOSE lives are closely related to living and making a living on American farms, the year 1862 is truly a memorable one. That year marks the establishment of the land-grant colleges, the U.S. Department of Agriculture, and the passage of the first homestead law.

Over and above their distinguished service record, these great institutions are symbols of a larger truth that is generally overlooked. This truth is that our machine age, including our scientific agriculture, is mainly the unfolding of a heritage of political and ethical beliefs which first emerged with the revolutionary upheavals of the late 16th- and 17th-century Europe. Then, under 200 years of predominantly agricultural conditions in the New World, they became so ingrained in American character that, upon the close of our pre-machine era around 1860, they were taken over by the builders of modern industrial America and used as dominant guides to life and problems of social organization without major overhaul until the Great Depression. Even the modifications since then have not been world shaking by any means.

In developing this theme, we first need to identify the key belief and value components of this heritage, which we may call our rural heritage in the sense that the great majority of those participating in its making were farm people, mainly family farmers. After identifying these components, we shall turn to the part played in their development by the 200-year evolution of the predominantly agricultural society of pre-machine America which roughly extended from 1660 to 1860.

The Belief and Value Components of Our Rural Heritage

The main aspects of our rural heritage fall into three basic groups of concepts, which we call the work ethic, the democratic creed, and the enterprise creed.

The Work Ethic: A useful point of departure in developing the components beliefs of the work ethic is the everyday observation that a most dominant drive of men is for an increasingly worthy image of themselves in their own eyes and in the

eyes of others. This ever finer self-image is the most spiritual or nonmaterial of all treasures. You can get no photograph of it; neither can you weight it, nor store it in vaults or barns; it has no abode in earth or stone—yet we seek it above all else. This striving is common to people of all cultures, but they differ as night from day with respect to beliefs concerning what way of living and of making a living proves that one possesses qualities of mind and character that deserve a favorable valuation of personal worth and dignity.

Many primitive peoples, such as the Tasmanians, held that proficiency in scalping and head-hunting was the proper test of such worth. When Westerners suppressed this test without providing a substitute, they plunged the Tasmanians into despair over the meaninglessness of life. As DeGrazia observed, the Westerners—

... cut the roots of the religious life of the natives. They no longer knew how to propitiate the gods. Their religion was undermined . . . They grew apathetic, indifferent to work and the future, and at the same time so proficient in abortion that the tribe was committing suicide by depopulation.¹

Relatively noncommercial farmers, mostly family farmers, of premachine America were singularly distinguished by the deep-seated belief that increasingly superior initiative and industry in any employment of one's choice is the proper way of proving that one possesses qualities which deserve his own highest respect and esteem, and also the esteem and respect of others. The spirit of this belief has never been expressed more truly than by Hiram Goff, a New England shoemaker, in his conversation with his minister, John Jessig. To strike up pleasant chatter, Goff remarked:

I believe in honest work; work is the law of Nature and the secret of human happiness.

His minister replied:

I am glad to see a man who can use the humblest vocation to the glory of God as you are doing.

This made the shoemaker's hair stand on end. Said he:

There ain't so such thing in this wide world, pastor, as a humble vocation. Listen, you are a minister by the grace of God . . . I am a shoemaker by the grace of God. You'll carry up to the judgment seat a fair sample of the sermons you preach, and I'll carry up a fair sample of the shoes I've been making. If your sermons are your best, and my shoes are my best, He'll say, "John and Hiram, you have used your talents about equally well. It's just as necessary for people to have good shoes as it is good sermons."²

In his simple eloquence, this shoemaker was doing far more than correcting a slip of his pastor; he was voicing beliefs that have been indigenous to farm people since the days of Plymouth Rock. Guided by this belief, no people will be forever

prisoners of low productive technologies. This was especially true of farmers of the premachine era. In pushing the frontier across the face of the continent, their actual behavior was that of a people in rebellion against low productive technologies which chained them to the bondage of a subsistence agriculture—a rebellion which they shared with all ranks and classes of men—a rebellion which included the fires of the American Dream—a rebellion that springs from commitment of mind and conscience to the belief that people fail in their duty to do all they can to remove want and privation from their own household, their country, and even the whole earth unless they keep a watchful eye for ways of increasing without limit the productive power of their hands, and in this way achieve the Biblical promise of man's dominion over his surrounding universe.

This attitude completely transformed the symbolic character of the wild continent. To the native Indian, the immense continent was an eternal assurance of his leisurely mode of life. To those seeking a workbench on which to prove themselves, it was in an almost literal sense "the substance of things hoped for, the evidence of things unseen." As men saw the oak in the acorn, so they envisioned farms in swamps and thickets, ports and thriving cities on river bends, paths of commerce along the wild-game trails, and with this vision came the strength to fell the mighty forests, bring forth the fruited plain, scale majestic mountains, and place their cattle on a thousand hills.

As our rural and national work ethic thus calls for an increasingly serviceable individual, so it likewise calls for an increasingly serviceable state or society. For the judgment that a key responsibility of the individual is to earn high standing through superior industry obviously includes the belief that the key reciprocal responsibility of society is to (1) provide its members with access to productive roles in keeping with their abilities; (2) give each a fair return for his contributions; (3) and make available to each the means necessary for developing his potential to the fullest extent possible. These three responsibilities of society are all caught up admirably in what we commonly call "the justice of equal opportunity." They constitute our work ethic sense of equity.

Expressed in political behavior, our work ethic directives generate the service state—a state that is on the ball, helping people help themselves. In premachine America, this kind of state took the form of massive aids (for that period) in building up such social overhead capital in the form of vast networks of roads, canals, navigable rivers and harbors, and railroads—services which were beyond the reach of the separate individual's efforts but which were indispensable to achievement of a better life through superior industry.

The Democratic Creed: As deeply rooted in our rural heritage as the work ethic beliefs, are the

¹ DeGrazia, Sebastian, *The Political Community: A Study of Anomie*, Univ. Chicago Press, Chicago, Ill., 1948, p. 48.

² Cited by Frederick Brown Harris, *The Evening Star*, editorial page, Washington, D.C., Oct. 30, 1955.

two central premises of the democratic creed: (1) All men are of equal dignity and worth; and (2) none, however wise or good, is good or wise enough to be invested with arbitrary power over any other. These presuppositions generate strong respect and appreciation of the dissenters, role in our common life—a fact which is expressed in the judgment that both the individual and his group (or groups) are responsible for seeking a new mode of thought and practice that will unify the hitherto conflicting views of each. In line with this judgment, (a) the community prizes its dissenting members as its agents for achieving new knowledge and practices that will enrich the life of all; and (b) the dissenter in turn feels a strong obligation to identify himself with his own exceptional sentiments and views as means of discovering and presenting his community with solutions for its problems—new truth, new art forms, new songs, new ways of relieving pain and of achieving happiness in all walks of life. This judgment binds the community and the dissenter together with bonds of mutual respect despite their differences. This ethic bears good fruit. There is hardly an implement of modern life, a piece of art, or a law of science whose history does not run back to where it once had no other home than the strange notion of some dissenter.

The Enterprise Creed: Along with the work ethic and democratic beliefs, our rural heritage includes the two rockbottom beliefs that make up our historic enterprise creed. (1) To the individual or his immediate family belongs and ought to belong complete responsibility for his own economic security through life; therefore, a prime function of government is to prevent the improvident from saddling others with the burden of their own economic security. (2) To proprietors (or their legal representatives), belongs and ought to belong complete power to lay down the rules they may choose for operating their own businesses, irrespective of whether the business be the operation of a production organization, or determining the terms and conditions under which one will sell and deliver his labor service, or handling his personal income, or his life in general.

Opposite Meanings of Freedom: Our democratic and enterprise creeds include opposite meanings of freedom. The premises of the democratic creed include a positive concept of freedom, according to which the hallmark of freemen consists in their having an equal voice in deciding upon what rules all must observe for the sake of the mutual welfare. In sharp contrast, the enterprise creed includes a negative concept of freedom, according to which the hallmark of free men is the mere absence of collective restraints on individual action. To be free is to be left alone, undisturbed in the power to run one's business as he chooses.

Seldom is there a serious policy problem which does not involve a clash of these opposite meanings of freedom. For example, in the 1930's there developed a tremendous desire among millions of people for liberation from agonizing economic insecurities. They sought to achieve this new liberty through a democratic process in which people, exercising equally sovereign voices, agreed to have their government collect a certain percentage of each individual's earnings with the understanding that upon reaching a certain age, it would return him a specified income, and in this way protect all against destitution that was striking down great numbers of people in their later years. But in thus seeking to exercise the positive meaning of freedom in their democratic creed, they collided with the negative meaning of freedom in their enterprise creed which is incompatible with collective restraints on one's Nature-given right to spend all his earnings as he chooses.

Two factors make especially difficult the achievements of liberations from the ills of unrestrained individual action. First is the very common confusion of the negative meaning of freedom in our enterprise creed with its positive meaning in our democratic creed. For example, in the 1930's social security numbers were equated with numbers of prison inmates on the ground that people would turn their whole, free society into one big jail if they chose to liberate themselves from the miseries of economic insecurity by using their government to carry out mandatory savings programs. In thus confusing the democratic meaning of freedom as an equal voice in laying down the rules, with the enterprise meaning of freedom as a mere absence of collective restraints our only choice is posed as one between our democratic way of life and such total evils as the "garrisoned state," "communism," and the like. Choice is thus made to appear as decision between total good and total evil, rather than between competing goods. Since everyone is almost automatically for good and against evil, what is needed to resolve our problem is not analysis of the relative merits and demerits of competing goods but the stirring up of righteous fervor against alien "isms" that are said to be eating out the foundations of our American way of life. In this way, our powerful allegiance to democratic beliefs is made the handmaiden of enterprise beliefs that our American way is threatened by collective action in line with our work ethic demands for more equitable rules of living and of making a living.

In addition to this fact, a formidable obstacle to liberation from specific ills, through democratically generated restraints on individual action is the exceedingly heavy weight which our rural heritage gave to enterprise beliefs. Two observations bear out this point. First, if today we gave the same heavy weight as our fathers did 100 years ago to the historic enterprise belief that to the individual belongs complete responsibility for his

own economic security, our Government-sponsored social security programs would be wiped out forthwith. Again, if we gave as much weight as they gave to the belief that to proprietors (or the legal representatives) rightly belongs complete power to run their business as they choose, we would instantly wipe out our legal requirement of collective bargaining between labor and management.

Image of the Good World: Thus, the greater the weight which people may assign to our enterprise beliefs, the smaller is the extent to which they are willing to expand the role of government in economic affairs. In line with this fact, our rural heritage of very heavily weighted enterprise beliefs generated strong devotion to a unique image of the good world. This image is expressed in the belief that the best of all conceivable forms (models) of social organization is one which divides all human activities into two distinct spheres. The first is a large natural order which is characterized by an absence of collective restraints on individual action.

John Locke called this component of the good world the "State of Nature," Adam Smith baptized it with the new name of "natural liberty," and today we call it the "free market." The second sphere of the good world is a small political domain of popularly controlled (constitutional) government that scrupulously abstains from laying down any common rules that interfere with the natural right of proprietors to manage businesses as they choose.

In his famous saying that "that government is best which governs least," Jefferson caught up rural America's devotion to this Lockean image of the good world. The same spirit reaches crescendo in the closing lines of Jackson's veto of the bank renewal bill in 1832:

Equality of talents, of education, or of wealth cannot be produced by human institutions. In the full enjoyment of the gifts of Heaven and the fruits of superior industry, economy, and virtue, every man is equally entitled to protection by law—if [government] would confine itself to equal protection, and as Heaven does its rains, shower its favors alike on high and low, the rich and the poor, it would be an unqualified blessing.

Uniquely weighted beliefs of the work ethic, the democratic creed, and the enterprise creed, all caught up in the Lockean image of the good world—these are the key components of our truly magnificent rural heritage from pre-machine America.

The Older Traditionalist Culture Out of Which Our Heritage Emerged

To bring out the part played by the 200-year evolution of our agricultural society in the development of our rural heritage, we first need to bring into focus the salient features of the older civilization out of which modern Europe and America began emerging in a big way during the 1600's.

Often called feudalism, but more accurately known as traditionalism, this older civilization was a system of master-servant beliefs and correlative institutions which still characterize most of the so-called underdeveloped countries. In considerable measure, they were also transferred to the New World, but they were overcome more quickly here than elsewhere so that while America is the youngest of the great powers, she is the oldest of the democracies. Four aspects of this older order are relevant to our problem.

(1) It distinctly segregated the managerial and labor functions into separate classes. Known as lords, the managerial classes were viewed as essentially personifications of divine-like wisdom and power to administer justice. Those saddled with the work of the world were viewed as so lacking in intelligence and self-control that they were essentially personifications of subservient labor and turbulent passions, fit only for producing subsistence for the whole community.

(2) This segregation of functions was the outward expression of the inward belief that exemption from economic employment is *prima facie* evidence of qualities of mind and character which entitle people to the highest stations, and that dependence on such employments proves that people are so deficient in meritorious capacities that they deserve only the lowest stations, even servility. In keeping with this belief, the main function of dress was to symbolize men's desert to higher or lower stations according to the degree of their exemption from, or dependence on, employments having to do with fashioning the material means of life.

In considerable measure, this traditionalist belief was carried over to the New World. Thus, in an excellent analysis of the social structure of America in the 1700's, Nettles observed that "when adorned with pearl necklace, gold pendant, silver earrings, and gold rings, a lady was not to be mistaken for a woman who worked at menial tasks, nor could her husband or father be ranked as other than a member of the upper class."³

(3) This whole hierarchy of superiors and inferiors was the institutional expression of the inward belief in *natural inequality* as the proper guide to relating man to man with reciprocal rights and duties in all spheres of life. Except as tied to mind and conscience by this belief, the whole hierarchy would fall to pieces like a rope of sand. So total was the acceptance of this inequalitarian axiom, that the equalitarian vision of Biblical lore was squeezed into a projected realm beyond the grave; in heaven and before God all men were of equal dignity and worth; on earth they were related only as superiors and inferiors.

In line with this fact, the individual was invested with only those rights and duties which marked him as the instance of a particular class. Thus, one man was invested with the rights and

³ Nettles, Curtis P., *The Roots of American Civilization*, Appleton-Century-Crofts, Inc., New York, 1938, p. 308.

duties of all serfs; another with the rights and duties of all artisans; another with the rights and duties of all landlords, and so on. Traditionalist commonsense thus tossed aside as nonsense the democratic belief that all men have a common nature which entitles each to the same bundle of rights and duties, whatever their particular social (class) roles may be. Carried to the New World, the older traditionalists' belief in natural inequality became the justifying grounds of Negro slavery for over 200 years.

(4) The legal foundation of this inequalitarian system of institutions was a form of ownership which combined both proprietary and sovereign power within the same skin. The feudal lord, such as William the Conqueror, for example, not only was the proprietor of his estates but also the legislator who laid down the rules for those who resided on his lands, the judge who levied penalties for infractions of his own decrees, and the police force who executed his own sentence.⁴

To assure continuity of both sovereignty and proprietary powers with the same family line, this species of ownership took the forms of primogeniture and entails. In later stages of development, it also took the form of quit-rent—"a fixed money equivalent of the food and labor payments exacted by the lord of the manor,"⁵ and which remained the same from year to year "whether the price of land rose or fell."⁶ Except for the corporate colonies of New England, vestiges of feudal tenure were transferred to Colonial America where they were not wiped out until the Revolution.⁷

16th- and 17th-Century Religious Reformers and Natural Rights Philosophers as the Beginning Points of Our Rural Heritage

The strategic beginning points of our rural heritage are a few revolutionary concepts that were first generated by 16th-century religious reformers and 17th-century Natural Rights philosophers, which breathed into men, as it were, a new mind and conscience that turned them against their past and sent them forth as builders of a new civilization.

(1) In their breakaway from the Mother Church, the 16th-century religious reformers had to face up to the question of what occupation is most truly appropriate for the upright man. According to the traditional view, such employment was boxed up in the monasteries where every moment of the 24-hour day was organized into systematic series of routines that were known as the Holy Callings. Against this view, the re-

formers took the position that all employments, whether composing sermons, painting pictures, making mousetraps, or growing corn, are equally appropriate ways of showing that one possesses qualities that deserve his own highest respect and esteem, and the respect and esteem of others as well.⁸ This expansion of the concept of God's work to include all occupations released an avalanche of productive aspirations that literally reshaped the world. Vast energies that hitherto found release in building great cathedrals now found new expressions of the heavenward urge in sailing the seven seas, turning deserts into gardens, conquering pests and disease, breeding scrub stock into fine herds, transforming hovels into firesides of good cheer, and building new social worlds; new churches, new schools, new governments—new ways of living and of making a living in all spheres of human endeavor. These were the new songs of salvation. Thus was born the pivotal belief of our national work ethic.

In the British Isles, in Switzerland, in Holland, in France, and along the Rhine, devotees of this radical view of the ethical significance of proficient work in any employment of one's choice began multiplying from the late 1600's through the 1700's, and setting forth to the New World. Throughout the 1800's they spread their views of life across the continent in one great revival movement after another on the westward moving frontier of America.⁹ At the time of the Revolution, well over half the white population stemmed from European immigrants of various Protestant reform groups, all committed to the belief that striving for increasing proficiency in one's daily work is the proper way of earning high standing.¹⁰

⁸ Detailed documentation of this point is omitted here for lack of space and because primary investigations are well known: Weber, Max, *The Protestant-Ethic and the Spirit of Capitalism*, Butler & Tanner Ltd., London, second impression, 1948; Troeltsch, Ernst, *Protestantism and Progress*, Beacon Press, Beacon Hill, Boston, 1958 (first published 1913); Tawney, R. H., *Religion and the Rise of Capitalism*, Harcourt, Brace & Co., New York, 1926; Harkness, Georgia, *John Calvin: The Man and His Ethics*, Abington Press, Nashville, 1958, see especially ch. VII. As interpreted in this paper, the work ethic is not to be equated with the usual interpretation of the so-called Protestant ethic. There is a causal connection between the two, but the work ethic is so indigenous to the usual American that he respects it, whereas the usual interpretation of the Protestant ethic, so called, is distasteful to him. For example, Weber equates the spirit of the Protestant ethic with asceticism which to most modern ears is a desire for self-punishment for its own sake. The same principle applies to the Protestant ethic as interpreted by Eric Fromm in *Escape From Freedom*.

⁹ For instructive accounts of Protestantism in America, see Will Herberg, *Protestant, Catholic, Jew*, Anchor Book, Doubleday & Co., Inc., Garden City, New York, 1960, pp. 99-125; Jerald C. Brauer, *Protestantism in America*, Westminster Press, Philadelphia, 1953; especially pp. 30-47, 102-116; H. Richard Niebuhr, *The Kingdom of God in America*, The Shoe String Press, Hamden, Conn., 1956, especially pp. 1-15, 17-44, 127-163.

¹⁰ Perry, Ralph Barton, *Puritanism and Democracy*, Vanguard Press, New York, 1944, pp. 62-81.

⁴ Bond, Beverly, W., Jr., *The Quit-Rent System and the American Colonies*, Yale Univ. Press, New Haven, Conn., 1919, p. 25.

⁵ Ibid., p. 18.

⁶ Ibid., pp. 34-41.

⁷ For a good account of the way Revolution swept away vestiges of feudal land tenure, see Franklin F. James, *The American Revolution as a Social Movement*, Princeton Univ. Press, 1940, p. 33 ff.

For two centuries these people came to the New World in five main streams. First were the New England Puritans whose descendants spread throughout New England on to New York, and finally into the Ohio Valley. Second, was the great stream of over 150,000 Presbyterians of Scotch-Irish immigrants in the 1700's. They were descendants of Presbyterian Scots who in the reign of James I had settled in Ulster on the confiscated estates of rebellious nobles. Because of economic discriminations, religious persecutions, and land evictions, they took refuge in the New World. Entering the Middle Atlantic ports, this stream of Puritans flowed South along the Shenandoah Valley, turned West over the Alleghenies, and traversed the present States of Kentucky and Tennessee and on to the Ohio Valley.

Along this route a little earlier also flowed a third stream of Puritans. These were German immigrants from the Palatinate and Switzerland, and belonged to the reformed or Calvinistic branch of Protestantism. Beginning in 1709, and climaxing in the middle of the century, this migration was the effect of war, invasion, persecution, and economic distress that had continued in Western Germany almost uninterruptedly since the outbreak of the Thirty Years War.

A fourth stream of Puritans were the French Huguenots, coming to America after the Revocation of the Edict of Nantes in 1664 and settling in considerable number in South Carolina. A fifth stream were members of the Dutch Reformed Church who settled in New York and constituted an independent colony until 1664. Like the Huguenots they were good Calvinists. Other powerful sects, included in the Puritan Calvinist branch of the Protestant Reform movement, were the Baptists and Methodists.

Inflows from similar ethnic groups continued until around 1860, as it was not until the Civil War that streams of European migrations shifted from the British Isles and Northwestern Europe to eastern, southeastern, and southern Europe.

(2) Committed to the belief that all employments are equally worthy opportunities of showing one's devotion to the services of God and men, these people found intolerable this older social order that gave highest standing to those who lived without work and saddled those who worked with inferior standing. Their mind and conscience cried out for a new image of the good world that made sense—a new political and economic model of social organization resting on completely new beliefs and presuppositions concerning human nature.

(3) The Natural Rights philosophers, especially John Locke, met this need in a systematic, organized way. In his *Second Treatise on Civil Government*, first published in 1690, Locke's immediate purpose was to ease the conscience of good, law-abiding Englishmen who had dethroned their legitimate king in 1689 and brought in William

and Mary from Holland. But in serving this specific need, Locke was spelling out new political principles which were already taking shape in the commonsense of the New World. Locke's problem was that of setting up acceptable presuppositions that would yield a formula of voluntary activity in which men could liberate themselves from the ills of unrestrained individualism through combining themselves into collective bodies (including government) under common rules without giving arbitrary power to anyone.

People on the pioneering edges of the New World had been in the middle of this problem for 70 years before Locke began writing his book. He was mindful of this fact. His imagery and illustrations are those of a man setting down in orderly fashion the beliefs and presuppositions of political science that were taking shape over here. This is why his major premises are important in understanding the role of our pioneering agriculture in developing our heritage of beliefs and values. Four observations bear out this point.

(a) Over against the inequalitarian institutions and beliefs of the precapitalistic landlord civilization, Locke set up a completely equalitarian image of Nature-made society. He put his point this way. In the "State of Nature," men are "equally kings," each being "absolute lord of his own person and possessions, equal to the greatest, and subject to nobody . . . without a common superior on earth with authority to judge between them."¹¹

Note the implications. In this statement, Locke was obviously slipping inside each skin the managerial and labor roles which the older master-servant hierarchy had distinctly segregated into lords and serfs; otherwise he could not say each man is an "absolute lord . . . subject to nobody . . . without a superior on earth to judge between them." In this recombination of roles, Locke is clearly using each individual or family as his irreducible social unit. This means two things. *From an economic standpoint* his social atom is a family unit of production (business) in which Nature invests the proprietor (1) with complete power to operate his business in any way he pleases, and also (2) with complete responsibility for his own economic security from the cradle to the grave. (In Locke's terminology, the word "estate" is equivalent in meaning to "family production unit.") *From a political standpoint* his social atom is a unit of absolute sovereignty, each individual or family being equally lawmaker, judge, and policeman. In this way, Locke generated the vision of a Nature-made society in which each man has a status of equal dignity and worth, not only because he is the Child of God, but also because Nature invests each man with both proprietorship and kingship.

¹¹ Locke, John, *Treatise of Civil Government*, book II, ch. IX, secs. 19 and 123, 1690.

Locke is often criticized on the grounds that his social atoms of equal sovereignty and proprietary power were unreal, existing nowhere except in his imagination. In a sense the critics are right, but on the frontiers of the New World his social atoms were real enough. The hunters and trappers like Daniel Boone who first pierced the wilds and found the trails over which the home and farm building settlers later traveled, the prospector on his lonely quests for precious ores, the settler with itchiest feet who raced ahead and cleared a spot with the idea of selling out for a nice price to slower oncomers from the rear, the cowboy and rancher who first staked their spreads on the treeless plain—all these men were forward agents of our expanding agricultural society. In a very real sense, they were “equally kings, each being absolute lord of his person and possessions, equal to the greatest and subject to nobody . . . without a common superior on earth to judge between them.” To such men, no laws of Nature were so obvious as the two central premises of the democratic creed: (1) All are of equal dignity and worth, and (2) none, however wise or good, is good or wise enough to be invested with arbitrary power over any other.

(b) But the fact remains that on the pioneering edges of our earlier agricultural society, men needed no philosopher to tell them that in the complete absence of collective restraints on individual action, men turn on each other like wolves. Locke called this the “inconveniences” of the “State of Nature”;¹² but the pioneers would prefer Thomas Hobbes’ saying that life in such a State is “solitary, poor, nasty, brutish, and short.”¹³ This fact presented the tough practical and theoretical problem of deriving a formula whereby equally sovereign men could liberate themselves from the ills of their unrestrained individual actions through setting up a common political authority to service their needs without giving arbitrary power to anyone. The formula Locke spelled out was the one which the pioneers were already using under the guidance of their common-sense. He derived it this way: Starting from the premise that men are equally kings and proprietors, he reasoned that their good sense would cause them to get together and liberate themselves from their mutual aggressions by agreeing to hand over to a specialized group the power of each to be lawmaker, judge, and policeman. Called the government, this specialized group would then lay down the rules for all with the tacit understanding that they have the power to do this only as long as the “governed” believed they are managing the commonwealth in line with the general welfare.¹⁴

Locke has the distinction of being the first to derive from logical premises this formula for setting up governments based on the “consent of

the governed”; but our struggling agricultural society has the distinction of actually practicing it much before Locke’s own native England did so. Passengers of the *Mayflower* were using it 70 years before Locke gave a systematic theory of their practice. In organizing wagon trains and other voluntary societies as well as town, county, and State sovereignties, the same process was continually repeated on the advancing edges of the frontier all the way from the Atlantic to the Pacific. There is thus no mystery in the fact that Jefferson never spoke more truly than when he said that in composing the Declaration he was merely voicing “the American mind,” aiming at neither “originality of principle or sentiment.”¹⁵ Neither is there any mystery in the fact that 13 years later, the Founding Fathers were eminently successful in drawing up from scratch the world’s first written Constitution. For it is questionable if any people in history ever had as much experience in building up self-governing bodies from the grassroots as did our predominantly agricultural society of 1789. It is often said that the Hand of God was in what the Founding Fathers did. Few would gainsay this. But we should not forget that they also had within their very bones, as it were, a 150-year tradition of making self-governing bodies pretty much along the lines of Locke’s systematic statement of political concepts in 1690.

(c) In generating these concepts, Locke also etched an image of the good world which was far more indigenous to the evolving agriculture of pre-machine America than to Locke’s own native England. He formalized the image this way: In agreeing to hand over to the legal agents their Nature-given rights to be lawmaker, judge, and policeman, Locke reasoned that each of the Nature-made “lords” retained all his Nature-given proprietary power to manage his business or estate as he chose, and also his Nature-given responsibility for his own economic security. Only for the sake of gaining greater protection of their proprietary status, did men agree to delegate their power as lawmaker, judge, and enforcement officer to a central authority in the first place. In thus giving such heavy weights to enterprise beliefs, Locke was the first to put into systematic theory the rock-ribbed conviction of our evolving agricultural society that the form of political economy which can most nearly fulfill our wants and aspirations is one which divides society into two spheres. The first is a large natural order characterized by the absence of collective restraints on individual action. Second is a small political sphere of popularly controlled government which provides proprietors with services they need in furthering their businesses but cannot provide for themselves.

¹² Ibid., ch. II, sec. 13.

¹³ Hobbes, Thomas, *Leviathan*, pt. 1, ch. 13.

¹⁴ Ibid., ch. IX.

¹⁵ Padover, Saul K., *Jefferson*, Harcourt, Brace & Co., New York, 1942, p. 54.

(4) The Age of Jackson (roughly 1820–60) was an outstanding approximation of this Lockean image of the good world. Five observations bear out this point. First, that period witnessed the triumph of the belief that “the people” and not any elite are and ought to be the true masters of government. Second, in no other period has government more scrupulously abstained from any action that would limit the power of proprietors to run their business as they choose, or relieve anyone of responsibility for his own economic security from the cradle to the grave. Third, in few if any other periods has government been more useful in providing proprietors with services they needed in furthering their businesses but which they could not provide for themselves. As previously explained, these services were huge public aids in the developing of vast networks of roads, canals, and navigable rivers that were indispensable to improved markets and property values. By 1840, individual States alone had spent \$200 million on internal improvements.¹⁶

Fourth, in no other period have our people made work ethic beliefs such complete handmaidens of enterprise attitudes. By this we mean that successful proprietorship was accepted on every hand as *prima facie* evidence of whether or not one was actually devoted to the belief in superior industry as a proper way of proving himself worthy of high standing. If one wound up the victim of economic insecurity, that was merely evidence of a misspent life—habitual distaste for work ethic directives.

If, on the other hand, he started out with his bare hands and wound up a successful proprietor, that was unquestioned proof of his devotion to work ethic beliefs—a devotion which entitled him to highest respect and esteem. This spirit of the age has never been expressed more truly by anyone than Lincoln:¹⁷

What is the true condition of the laborer? I take it that it is best for all to leave each man free to acquire property as fast as he can. Some will get wealthy. I don't believe in a law to prevent a man from getting rich; it would do more harm than good. So while we do not propose any war on capital, we do wish to allow the humblest man an equal chance to get rich with everybody else. When one starts poor, as most do in the race of life, free society is such that he can better his condition; he knows that there is no fixed conditions of labor for his whole life. I am not ashamed to confess that twenty-five years ago I was hired labor, mending rails, at work on a flatboat—just what might happen to any poor man's son. I want every man to have a chance—and I believe a black man is entitled to it—when he may look forward and hope to be a hired laborer, this year and the next, work for himself afterward, and finally to hire men to work for him. That is the true system.

¹⁶ Carman, Harry J., Syrett, Harold C., and Wishy, Barnard W., *A History of the American People*, Alfred A. Knopf, New York, 1961, vol. 1, p. 466.

¹⁷ *In Complete Works of Abraham Lincoln*, ed. by John G. Nicolay and John Hay, vol. V, p. 361.

Finally, as the conditions of our evolving agriculture in premachine America were such as to render work ethic beliefs the servant of enterprise beliefs, so they likewise rendered work ethic beliefs the servant of democratic beliefs in popularly controlled government. This is why. Caught up in their conquest of a formidable continent, pioneering farmers quickly acquired a commonsense that turned them against every vestige of old beliefs that exemption from economic employments was evidence of superior qualities of mind and character that entitle one to the highest positions. Confirmed in this rebellion by such commonplaces as the uselessness of white gloves and lace wristlets in living and making a living, they became increasingly suspicious of the alleged superior political wisdom on the part of those whom Hamilton called “the rich and the well born”; more and more they equated such knowledge with those whom Jackson called “the humble members of society.”

Thus the burning concern became what symbols are the indicators of highest merit—calloused hands or silver buckles. In line with their work ethic directives, pioneering farmers came to look on their own proficient industry as proof of civic and moral superiority over those who lived without work. This proof strengthened their legs so that they could stand up against the last vestiges of traditionalist beliefs and demand a government that recognized humble origins as indices of highest esteem.

The presidential campaign of 1840 marks the high point of this battle of symbols. For in that year aristocratic Whigs concluded that they could win another national election only by throwing off their broadcloth in favor of log cabins and hard cider so convincingly as to hang the onus of aristocracy on the Jacksonian Democrats. Typifying the lead scouts in this battle, Webster shouted that “the man who says that I am an aristocrat is a liar: and he who makes this charge and then will not come within the reach of my arm, is not only a liar but a coward.”¹⁸ This delightful horseplay marks the disappearance from the American scene of the age-old presupposition that exemption from the heat and grind of life is in and of itself somehow evidence of a superior wisdom to know what ought and ought not be done for the good of the world.

Turning Feudal Beliefs to the Service of Democratic Ends

So far we have been bringing out how our evolving agriculture or premachine American contributed to radical departures from an older master-servant system of beliefs and correlative institutions. We should now like to bring into focus the astonishing fact that they also turned to the service of democratic ends a foundation premise of our older feudal civilization.

¹⁸ Cited by Arthur M. Schlesinger, Jr., *The Age of Jackson*, Little Brown and Co., Boston, 1945, p. 293.

This is true because there is a striking identity of mind (belief) between premachine America and the feudal mind out of which the New World evolved. For in both cases proprietorship was viewed as *prima facie* evidence that men possess that proud spirit of personal independence and civic responsibility which is indispensable to any stable society, and that tenantry and wage status are reliable proof of such a lack of purpose and managerial intelligence that no stable government was possible in terms of nonproprietors.

This ancient equation so guided and dominated the mind of the Founding Fathers that they were unable to envision the possibility of a democratic society in terms of a predominantly wage and salaried population. At the Constitutional Convention, James Madison expressed this state of mind in these blunt words:

In future times a great majority of the people will not only be without land, but any other sort property. These will either combine under the influence of their common situation, in which case property and liberty, will not be secure in their hands: or what is more probable, they will become the tool of opulence and ambition, in which case there will be equal danger from the other side.¹⁹

How, then, did the conditions of our evolving agriculture enable premachine America to hold onto the ancient equation of proprietorship with civic competence and at the time turn this feudal belief to the service of democratic ends? The answer is twofold.

The first condition was the presence of some 2 billion acres of virgin land. This condition so placed the opportunity of acquiring property within the reach of even penniless people that the Founding Fathers felt it a waste of time to incorporate in the Constitution a property qualification of voting.²⁰ There is thus no mystery in the fact that Daniel Webster declared:

A republican form of government rests not more on political constitutions, than in those laws which regulate the descent and transmission of property. Government like ours could not have been maintained, where property was holden according to the principles of the feudal system; nor on the other hand, could the feudal constitution possibly exist with us. Our New England ancestors brought hitherto no great capitals from Europe—They left behind them the whole feudal policy of the other continent—They came to a new country. There were, as yet, no lands yielding rent, and no tenants rendering service. The whole soil was unreclaimed from barbarism. They were themselves—nearly on a general level in respect to property. Their situation demanded a parceling out and division of the lands, and it may be fairly said, that this necessary act *fixed the future frame of their government*. The character of their political institutions was determined by fundamental laws respecting property.²¹

As the expansion of the Old World into the New pushed past the outposts of the Atlantic seaboard, the rise and growth of the institutions of the family farm on the moving frontier of America was the second condition that enabled man to hold onto the feudal equation of proprietorship with civic virtues and yet turn it to the service of democratic ends. For in combining within the same individual (or family) the hitherto separate managerial and labor roles of lords and serfs, these institutions enabled people to identify themselves with the same civic virtues which our older master-servant civilization reserved for feudal proprietors who lived without work. In this way, the family farm became the instrument that enabled premachine America to accept without question its inherited feudal equation of proprietorship with civic virtues and at the same time use the equation as a weapon for knocking down every vestige of feudal institutions and replacing them with democratic ones. This fact was expressed with uncommon clarity and eloquence by Thomas Hart Benton in the great land debates of the 1840's:

Tenantry is unfavorable to freedom. It lays the foundation for separate orders in society, annihilates the love of country, and weakens the spirit of independence. The farming tenant has, in fact, no country, no hearth, no domestic altar, no household god. The freeholder, on the contrary, is the natural supporter of a free government; and it should be the policy of republics to multiply their freeholders, as it is the policy of monarchies to multiply tenants. We are a republic, and we wish to continue so: then multiply the class of freeholders; pass the public lands cheaply and easily into the hands of the people; sell, for a reasonable price, to those who are able to pay; and give, without price, to those who are not. I say give, without price, to those who are not able to pay; and that which is so given, I consider as sold for the best of prices; for a price above gold and silver; a price which cannot be carried away by delinquent officers, nor lost in failing banks, nor stolen by thieves, nor squandered by an improvident and extravagant administration. It brings a price above rubies—a race of virtuous and independent laborers, the true supporters of their country, and the stock from which its best defenders must be drawn.²²

The very heart of our rural heritage lies in this ancient equation of civic virtue with proprietorship and the further tieup of this equation with work ethics beliefs and the democratic creed. This combination of beliefs was shared by all classes: by farmers, by lawyers like Webster, by storekeepers, by shoe cobblers like Hiram Goff, and by artisans like Longfellow's "Village Blacksmith."

It is to Jefferson that we mainly owe the claim of a virtual monopoly of virtue for farmers. He derived the claim from the ancient Self-Sufficiency Ideal of Freedom which is wholly incompatible with market interdependence. For within the

Plymouth Rock, in the "Works of Daniel Webster"; vol 1, pp. 5-6.

²² From a speech by Thomas Hart Benton, *Thirty Years' View: A History of the American Government for Thirty Years, from 1820 to 1850*, vol. 1, ch. IV, pp. 11-12.

¹⁹ *Documents Illustrative of the Formation of the Union*, Govt. Print. Off., Washington, D.C., 1927, pp. 489-90.

²⁰ Beard, Charles A., *An Economic Interpretation of the Constitution of the United States*, The Macmillan Co., New York, 1936 (copyright 1913), pp. 164-168.

²¹ *First Settlement of New England*, 1820, address at the celebration of the 200th anniversary of the landing at

older culture of the master-servant relationships and subsistence agriculture, the completely free man can be envisioned only as one who has under his absolute command all the personal and physical resources necessary to produce his own subsistence. Therefore, to feudal proprietors it was self-contradictory to think of men as free and at the same time dependent for their livelihood upon market exchange between producers and consumers. For this reason the feudal lord would have said that Jefferson took the words right out of his mouth in saying:

... dependence on the caprice of customers begets subservience and venality, suffocates the germ of virtue and prepares fit tools for the designs of ambition.²³

Obviously, this Self-Sufficiency Ideal of Freedom can be approximated only within the context of very low productive farm technologies which were common to both feudal society and pre-machine America. The combination of this circumstance with Jefferson's devotion to democratic beliefs on the one hand and his carryover of the ancient Self-Sufficiency Ideal of Freedom on the other, led him to see in the family farm the keystone of a democratic civilization in the New World. For by combining within each family the hitherto separate managerial role of feudal proprietors and labor role of feudal serfs, this institution enabled all farmers to be proprietors who produce their own subsistence. In this way, it liberated all farm people from dependence on anyone except themselves, including "the caprice of customers"; therefore, according to Jefferson, farmers and farmers alone, were solid building blocks of a sturdy democracy because they are personifications of that proud sense of personal independence which is the foundation of civilized life. Under the inspiration of this belief, Jefferson reached the rafters saying:

Those who labor in the earth are God's chosen people . . . whose breasts He has made His peculiar deposit for substantial and genuine virtue. It is the focus in which he keeps alive the sacred fire, which otherwise might escape from the face of the earth.²⁴

Clearly what counts in this reasoning is not that family farmers were proprietors but that they were a unique subspecies of proprietors who produced their own subsistence. In Jefferson's day, men like Longfellow's "Village Blacksmith" and other villagers were not less proprietors than family farmers. But their low productive technologies were associated with a very high degree of commerciality. By forcing them into dependence on "the caprice of customers" for their subsistence, this fact according to Jefferson generated within such proprietors a spirit of "subservience and servility," which rendered them a peril to the pub-

lic order. Laboring under this erroneous belief, Jefferson bluntly stated:

The mobs of the great cities add just so much to the support of pure government as do sores to the strength of the human body.²⁵

There is no mystery concerning the survival power of the Jeffersonian equation of farmers with superior moral excellencies.

For any group of people are most happy to be singled out and assured by high authority that they are "The chosen people of God: in whose breasts He . . . keeps alive the sacred fire, which otherwise might escape from the face of the earth."²⁶ So much is this the case that it would be less than human to expect farmers to stand up and deny it, and its oratorical potential is obviously too great to be overlooked by alert politicians and others seeking the good graces of the countryside.

Nonetheless, one highly distinguished farm boy and matchless politician did take exception to it. His name was Abraham Lincoln. Speaking to the Wisconsin State Agricultural Society at its annual fair in Milwaukee on September 30, 1859, he declared:

I presume I am not expected to employ the time assigned me in the mere flattering of farmers, as a class. My opinion of them is that, in proportion to their numbers, they are neither better nor worse than any other people. In the nature of things, they are more numerous than any other class; and I believe there are really more attempts at flattering them than any other; the reason of which I cannot perceive, unless it be that they cast more votes than any other.

All who share a lively concern for the well-being of farm people might ponder well these words of Lincoln, spoken a century ago. If we did so, our reflections might well lead urban and farm people alike to a richer, finer appreciation of the actual belief and value content of our truly magnificent rural heritage than is provided in that imagery which gathers round the ancient Self-Sufficiency Ideal of Freedom—an ideal which generates the image of superior merit in one occupational class by equating it with moral excellencies which, now as always, are actually common to all classes in approximately the same degree. Deceptive beliefs concerning merit generate hostility.

The Sense of Destiny

The most abiding element of our rural heritage is a magnificent dream of destiny which was born of the poetic aspect of the human spirit that animated our evolving agricultural society in pre-machine America. However severe the privations and cruelties of the new continent, it would nonetheless turn into marvelous shapes and forms under the touch of patient industry; and soon there emerged the inspiring vision of a whole wide

²³ Jefferson, Thomas, *Notes on the State of Virginia*, Query XIX.

²⁴ Ibid.

²⁵ Ibid.

²⁶ Ibid.

wilderness transforming into farms and homes and thriving cities in response to diligence and creative toil. In this way the poetry of the spirit joined the sinews of the hand with the stuff that dreams are made of. Thus was born the American Dream as the felt assurance of Nature and Providence alike that, in the creative powers, men have ample means of bringing their actual conditions increasingly in line with their aspirations.

This Dream divides into three component visions that have long constituted America's sense of national and individual purpose. The first component is the vision of a government increasingly concerned with the tribulations of all of its people—a vision that includes the belief that each individual is duty bound to do his part in bringing to pass this kind of government. The second component is the vision of an economic realm of peace and plenty—a vision that includes the belief that each individual is responsible for doing all he can to remove want and privation, even from the whole earth. The third component of the Dream is the awe-inspiring feeling that destiny had assigned America and all her citizens an auspicious part to play in furthering the age-old prophetic dream of a worldwide realm of law and justice.

Without these broadly organizing national and individual directives of her Dream, America would be lost. Owing to the driving power of her work ethic animations, her energies would be no less prodigious than before. But without the organizing directives of her Dream, her energies would increasingly turn into neurotic anxieties over the meaning and purpose of life. Many diagnosticians of the national character are saying this is precisely what is now happening. For the forests have been felled, the sod broken, the rivers spanned, and the conquest of the continent finished; therefore, our "formulation of national purpose" has run to the sand;²⁸ hence we tend to escape the boredom of our boundless activism with saying "have a beer" or "go to the races and forget it all."

But the Dream is not dead; only its targets are changing, both at home and abroad. For there is no greater illusion than the easy supposition that the frontier has ever passed from American life. As the rural frontier of wagon trails reached the Pacific, it soon reappeared as the urban frontier of tenement trails from slums and ghettos to sprawling suburbias, and in the trails of millions of immigrants from rural America, uprooted by modern farm technological advance and seeking a new destiny in our cities. Since 1930 more farm people than now live on farms have traveled along

the new immigrant trails from the farm to our new urban frontier, and the prospects are that this pionering enterprise will continue for many years to come. Thus, as the target of the American Dream in the 19th century was the transformation of forest and plains and deserts into fields of abundance, so its target in this century and the next is the transformation of urban blights into spheres of comfort and beauty. In releasing her prodigious energies in the huge conquest of her vast urban frontier of the 20th century, modern industrial America becomes the worthy keeper of the Dream handed on to her by the conquerors of her vast rural frontier of a century ago.

The same principle applies to the world scene, except that here change in the target of the Dream concerns methods of achievement. In the last century, the feeling was that if we avoided entangling alliances, practiced industry, conquered the continent, bettered our conditions of life under free institutions, the sheer attractiveness of our example would be sufficient to induce other people to do likewise.

But we have learned that this method of implementing the directive of our American Dream is highly unrealistic. Most of the world is still poor, caught in the coils of low productive technologies and master-servant types of institutions and beliefs which in turn generate and perpetuate impoverishing conditions. On the 20th century world scene, we are up against an implacable foe, animated by an almost fanatical belief that its world mission is to sweep away the older order and release the productive energies of men through methods that would destroy the security of our own position. Meeting this challenge calls for a great deal more than merely striving to be a good example of an increasingly productive and free life within our own borders. It calls for immense effort to place ourselves in the shoes, as it were, of developing countries and see their problems from the standpoint of their own ancient beliefs and institutions as well as our own, and in this spirit use our abundance in working out with them new ways of enabling them to take over our own science and technical skills and thus become as proficient as we in making Nature the servant of their needs under the guidance of beliefs and institutions that are friendly to our own.

Conclusion

Thus, on the ramparts of the world as on our urban frontiers, the directives of the American Dream are pointing as of old. Therefore, we can ill afford to throw away its underlying work ethic beliefs that were rooted so deeply in the life of the Nation when our fathers were poor and mostly farmers. The biddings of the ethic are eternal; for the building of the human temple is never done.

²⁸ *The National Purpose*, essays by a number of writers and a foreword by Henry R. Luce, Holt, Rinehart & Winston, New York, 1960, p. 131.

Discussion

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ANY EVALUATION of the significance of the development of American agriculture must be guided by a set of interpretative ideas. Our guiding ideas for such a venture would be somewhat different than those of Dr. Brewster. This means that our remarks here are not only highly selective but also supplementary to the principal paper.

The fundamental problem of national existence, as for individuals and families, is that of survival. It is the fact that national survival is again an urgent issue for many nations that gives meaning to a critical understanding of the foundation of our national enterprise.

Within such an orientation we would emphasize as of primary importance the system of government and economy, rather than the beliefs which we presume men to hold. It is not that beliefs are unimportant, but rather that public policy, especially in a free society, concentrates initially upon the system.

Consequently, we would hold that the significance of the agricultural progress which we are celebrating on this centennial occasion is to be understood in terms of the system of which agriculture is a part. Our forefathers were privileged to design and build a new political and economic system in an open continent. Although one could probably trace every idea, principle, and institution back to an earlier, European source, this achieved structure was indigenous and gave our people a fresh start.

The great landmarks of agricultural policy which we commemorate this year were as much the culmination of the preceding century as they were to become the foundation of the agricultural progress which has followed. A hundred years before the adoption of the Homestead Act of 1862, Adam Smith was already at work upon the *Wealth of Nations*. Thomas Jefferson, then 19 years old, was already mastering the ideas of John Locke. These men and their contemporaries were witness to that great watershed era of European history when industrialization was born out of the traditional systems of agriculture and handicraft.

Land, the Measure of Opportunity

In the closing decades of the 18th century when our systems of government and national economy were taking shape, the great majority of mankind in the Western World lived close to, and rather directly from the soil. With land the measure of opportunity, the terms of access to land was the battleline of freedom. The long struggle over the distribution of the public domain

which culminated in the Homestead Act was not a battle by the representatives of farmers alone. The laborers in the shops and factories supported the principle of free land, for this would preserve for them an avenue of escape from the insecurity and grinding toil of wage dependency. The agrarian statesmen believed the economic independence of farmownership to be a bulwark of political democracy—and in this belief they were not mistaken.

Any assessment of the dynamic influences at work in the development of this country during the century preceding the Civil War must accord great weight to manhood suffrage. It is this fact of widespread citizenship implementing a deep faith in equality, in an economic system honoring freedom and responsibility, which provides the common ground for the three great landmarks of agricultural statesmanship of 1862. Although the establishment of the continentwide system of private ownership of land with relatively great freedom of use and alienation was the culminating achievement in instituting a liberal system of government and economy, to a considerable degree the Homestead Act was an acknowledgement of practices already established. In an open continent, settlers were destined to occupy the land and claim it as their own by "mixing their labor with the soil"—to use John Locke's phrase. Already agriculture had become deeply integrated into the economy of money and markets, and the transformation was to proceed at a more rapid pace as a consequence of the industrialization and railroad building, hastened by the Civil War then going on. Already, one may say, the limits of the traditional approach to agriculture were genuinely understood. The year which marked the formal achievement of the homestead principle also inaugurated the land-grant system, dedicated to the principle that the practical problems of mankind can be understood and mastered only by fundamental research. Similarly, the Department of Agriculture was dedicated to the proposition that public service to people as citizens is a proper role of government.

Now, a century later, we take stock and wonder—about the future and the problems of the new nations with whom our fate has become so deeply intertwined.

During the past century our agriculture has been transformed from a system deeply self-sufficient to one predominantly interdependent with the larger economy. In this, we have traveled the road over which all nations pass on the way to economic development. But our own situation

was most propitious for this event. Although the settlers who peopled this land survived initially by the methods of self-reliance and self-sufficiency they were an uprooted people, aware of the advantages of markets and the functions of cities. Furthermore, they occupied the land under the terms of law and institutions designed to make landed property a part of a business economy—a mobile resource as economists would say. Through the wisdom of the Founding Fathers, the agricultural land was occupied under conditions of assured freedoms—once the problems of order at the frontier were resolved; the assurance was provided by representative government, secure access to opportunity on the land, and the liberty of citizenship.

Labor has always been relatively dear in this country, and subject to careful economizing by farmers, who have rarely been able to match the wage bids of industries and cities. With the development of industry nearby, the mechanization of an agriculture spread out over great stretches of land was relatively easy. The American farmers have always lived in something of a space age. The combination of all these circumstances placed American agriculture on the pathways of science and technology under circumstances uniquely favorable to technology.

Circumstances Favored Progress

With circumstances so favorable for progress in American agriculture, one must wonder as he considers the plight of a billion people on the land in the newly developing countries whether our experience has valid meanings for these people. I think it does. It is only that the obstacles to progress were less here. Our favorable circumstances permit us to see the possibilities of the key ideas and principles at work under near optimum conditions.

The distinction of public from private was inherent in the system of law and order which our forefathers brought to this continent. This functional differentiation was achieved in Europe only at the cost of centuries of trial and error and revolution. Our English forebears struggled for almost 500 years to move from the principle of limited royal prerogative inherent in Magna Carta to the Act of Settlement of 1700 which established dependable rules for representative government and secure citizenship by limited sovereignty and an independent judiciary. The struggle for a dependable public order in which freedom can be meaningful for all persons as citizens is still going on over much of the world—and this is the heart of the reform problem in the processes of economic development. The fact that we inherited and adopted a set of procedures which honored secure distinctions between public and private does not make our experiences with these categories less meaningful to mankind.

A Free Man; But Also a Responsible Man

The American farmer has been a citizen from the beginning of national independence. Even though this record is blemished by slavery and the routing of the native Indians, the significance of citizenship remains in the experience of the dominant majority. A citizen is a person clothed with the power of sovereignty. This is man in his public capacity. The citizen is not only a freeman, but must also be a responsible man—as Prof. Carl Becker has argued so persuasively in his “Freedom and Responsibility in the American Way of Life.” In this open land man was freed of repressions of state and church alike, and the liberty of the farmer who owned his land was implemented by property in a manner of which John Locke would have approved, but this freedom also placed squarely on each man and his family the responsibility for survival.

Among the greatest insights born of this conception of responsible freedom, shared by our farmers, and honored, I judge, by both the land-grant system and the Department of Agriculture, is that noted by Prof. G. H. Mead. Speaking of which he called the modern conception of freedom, he noted that this is—

“freedom to effect not only values already recognized, but freedom to attain as well such complete acquaintance with nature that new and unrecognized uses would be at our disposal. . . . This cult of increasing knowledge, of continually reconstructing the world . . . this modern conception proceeds not from the standpoint of formulative values, but giving society at the moment the largest possible number of alternatives of conduct . . . i.e., undertaking to fix from moment to moment the widest possible field of conduct. The purposes of conduct are to be determined in the presence of a field of alternative possibilities of action . . . The statement of the possible field of conduct is actually dependent on the push toward action.”¹

As the typical citizens of a century ago, the struggle of American farmers, over the decades that followed the Civil War, epitomized this “push toward action” out of determination to enlarge the field of secure possible conduct. Around and in response to this push toward action there has developed whole professions in agriculture, including agricultural economics, agricultural extension, and rural sociology. The ownership of the products of the land, with the correlative right of access to markets, energized our farmers and assured their vigorous and willing participation in the economy. But, having been accorded rightful opportunities on the land, the American farmers as citizens were from the first insistent that these opportunities be kept valuable.

Out of this way of thinking has come not only the conception of the independent farmer with freedom of access to markets, but also from this

¹ Arranged from G. H. Mead, “Scientific Method and the Individual Thinker,” in *Creative Intelligence—Essays in Pragmatic Attitude*, by John Dewey et al.

set of ideas has come the Agricultural Extension Service to develop the farmers' abilities; the regulation of markets to assure fair dealings; the agricultural credit services to adapt essentially urban procedures to the needs, risks, and careers of farmers; and even the cooperative movement which would combine farmers into groups to enable them to enjoy the benefits of collective action in an age of combinations.

Out of this same basic drive of farmers—this push toward action of citizens—has come also quite another line of public policy. Beginning with the drive to curb the monopoly power of railroads which culminated in the Interstate Commerce Commission, this line of attack, aimed at what may be called defects in the system, has culminated in our time in the vast programs of production control, price support, and public price-administration programs. These programs are controversial, and after 30 years remain provisional.

Public Policy Shifts Emphasis

When such programs are seen in coordinate relation to our Defense Establishment with vast Government spending, our social security, and our economic stabilization programs, it is clear that the relations between public and private are changing. Public policy has shifted in empha-

sis, back toward greater substantive participation by Government in economic affairs and away from the near-exclusive reliance upon procedural rules which was the ideal of classical liberalism.

No sector of the economy demonstrates more dramatically this transformation over the past century than agriculture. Yet, paradoxically, no sector of the economy retains in greater strength the effective functioning of the free economy of private ownership of land and free market access. Consequently, the design, the political support of, and the administration of agricultural programs have for 30 years been conducted on uncertain ground.

As one considers such developments in American agriculture, in relation to political thought and action, surely he must be impressed, and even amazed, at the capacity of American agriculture and rural society to adapt to and accept change. More than that, the farmers being exposed to unusual hazards and disabilities were among the original vigorous leaders of that push toward action which is reconstructing our world. In the early stages of economic development when most of the people are on the land, if the farming people can be energized into the push toward action of responsible freedom, that country is almost surely on the way to progress. At the least, it happened here.

Discussion—Continued

Sherman E. Johnson

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IN THIS PAPER as well as in several others which he has published in recent years, Brewster has given us new understanding of the influence on our development of basic beliefs which have originated in agriculture. These beliefs have shaped our attitudes, first of all, toward agricultural policies and programs; second, toward our entire economy and, in recent years, our approach to aid programs in developing countries.

As outlined by Brewster, the *work ethic* encompasses (1) the goal of equality of opportunity for each individual to assume a productive role in keeping with his ability, (2) a fair return for his contribution, and (3) access to the means of developing his potential. The *democratic creed* pronounces all men of equal worth and none good or wise enough to exercise arbitrary power over another. The *enterprise creed* gives each individual responsibility for his economic security, and proprietors complete control over their own businesses.

In keeping with these beliefs, we arrive at a general philosophy which includes a large sphere

of individual action and a small sphere of Government action. This philosophy functioned well on the American frontier, and was fairly well suited to the environment experienced by Thomas Jefferson and Adam Smith. But the world has grown more and more complex, and individuals as well as governments have had to deal with and will continue to deal with, problems unheard of at the time of the American Revolution.

I shall trace some of the steps we have taken to arrive at the mixture of individual, group, and Government action which now characterizes the American economy. We might begin by classifying the different modes of economic functioning with respect to Government activity as follows:¹

1. Individualistic—Let the individual do it.
2. Associationistic—Let the group or association do it.

¹ Apparently the late Prof. John R. Commons described three points of view with respect to the role of the state as (1) socialistic, (2) anarchistic (individualistic) and (3) syndicalistic (associationistic). See Black, J. D., "Production Economics." Henry Holt & Co., 1926, p. 957.

3. Paternalistic—Let the individual or association do it, but with State aid and State regulation.²
4. Socialistic—Let the State do it.

Lincoln's Maxim Followed

Our agricultural beliefs originated in an environment dominated by individually operated farm and business enterprises. Fortunately, farmers and all groups in our society have taken a pragmatic approach to solution of the problems which have arisen. In this approach they have adhered to Abraham Lincoln's maxim:

The legitimate object of government is to do for a community of people whatever they need to have done, but cannot do at all, or cannot so well do for themselves, in their separate and individual capacities. In all that the people can individually do as well for themselves, government ought not to interfere.³

Although Lincoln held that the Government ought not to interfere in any activity that people individually can do as well for themselves, he left considerable leeway for Government activity in doing whatever needs to be done that people cannot do at all, or cannot so well do for themselves. This approach permitted great flexibility, especially in providing such Government services as publicly supported education, research, and other services. If these had been excluded from Government activity, this Department and the land-grant colleges would not be celebrating their Centennial in 1962.

State and Federal Governments, provided for other types of assistance. The land laws which culminated in the Homestead Act (1862) provided settlement opportunities on the frontier. State and Federal Governments were called upon to provide roads, canals, and other public improvements. When the railroads had proved to be a practical means of transportation, agitation developed for railroad building to open up the frontier. The Federal Government granted 91 million acres of public domain to railroad corporations in the railroad building era. If State grants of public land are included, railroad land grants total about 130 million acres, more than the total area of all the New England and Middle Atlantic States.⁴ Apparently the individualistic laissez faire philosophy could be readily expanded to provide a large measure of paternalism.

In the post-Civil War period, railroad building and industrial development grew apace, stimulated

by State legislation which facilitated the organization and financing of business corporations. Protective tariffs provided additional encouragement to many industries. These developments represented an unconscious grafting of the associationistic and paternalistic modes of economic functioning on a stem of individualistic functioning while retaining the beliefs associated with individual activity.

The basic laissez faire beliefs still served as philosophic guides to Government policy despite apparent conflicts. For example, free trade is one of the basic postulates of classical laissez faire economics. And a large-scale business corporation is regarded, in legal terms, as an individual entity. It is treated as a corporate person, even though it is a far cry from the small shopkeeper so familiar in the world of Adam Smith. Failure to distinguish between the business corporation functioning as an association and farmers and workers functioning as individuals created much discontent in the later years of the 19th century. Family farmers and unorganized workers cannot bargain on an equal basis with a large corporate entity. "There is no greater inequality than equal treatment of unequals." The policies which were followed in the post-Civil War era were, however, peculiarly suited for encouragement of rapid economic development.

Railroads Brought Settlement

On the agricultural front, the Homestead Act and railroad building encouraged settlement of the prairies in the postwar years, and contributed to a market glut of farm products which was accentuated by a deflationary monetary policy. The resulting low prices of farm products, and the heavy debts incurred in developing a commercialized agriculture, prompted farmers to organize for their own protection. They tried to deal with marketing and purchasing problems through co-operative organizations. Although some early successes were achieved, these early attempts at associationistic functioning did not fulfill their original promises.

Farm organizations also were the prime movers in urging legislation for Government regulation of business enterprise, both in State legislatures and in the Congress. "The Act To Regulate Commerce" in 1887, creating the Interstate Commerce Commission, in a sense marked the beginning of Federal Government regulation of private business. The Federal Government became an "umpire" in the railroad game and later in other business activities. In 1890 Congress passed the Sherman Antitrust Act, which was designed to prohibit combinations in restraint of trade. Here we have the disciplinary rather than the benevolent side of paternalism.

The business regulatory acts passed during the latter part of the 19th century were designed to enforce competition in the American economy. To

² Webster's New International Dictionary, Second Edition, defines government paternalism as "the principles or practices of a government that undertakes to supply needs or regulate conduct of the governed in matters affecting them as individuals as well as in their relations to the state and to each other on the assumption that it can best secure their highest welfare."

³ Collected Works of Lincoln, vol. 2, p. 220.

⁴ "Uncle Sam's Acres," by Marion Clawson. Dodd, Meade & Co., 1951, p. 74. Large sums also were collected from municipalities and by private subscription to subsidize railroad building.

this extent they were in harmony with the basic agricultural beliefs, but they were also an attempt to force an individualistic mode of functioning on an associationistic business organization. Court actions and lack of rigid enforcement limited the applicability of regulatory legislation.

Theodore Roosevelt—Trust Buster

Corporate combinations grew larger and exercised considerable monopoly power. President Theodore Roosevelt recommended legislation to abolish abuses. "We do not wish to destroy corporations," he said, "but we do wish to make them subserve the public good."⁵ The "trust busting" campaign of Theodore Roosevelt eventually resulted in the breakup of the Standard Oil Co. President William Howard Taft proposed requiring Federal incorporation of companies engaged in interstate commerce, and establishment of a Federal Corporation Commission, but Congress did not act on this suggestion.

Woodrow Wilson's slogan in the 1912 presidential campaign was "The New Freedom." His philosophy is expressed in the following quotations:⁶

Business is in a situation in America which it never was in before; it is in a situation to which we have not adjusted our laws. Our laws are still meant for business done by individuals; they have not been satisfactorily adjusted to business done by great combinations, and we have got to adjust to them. I do not say we may or may not; I say we must; there is no choice.

* * * A modern joint stock corporation cannot in any proper sense be said to base its rights and powers upon the principles of private property. Its powers are wholly derived from legislation. It possesses them for the convenience of business at the sufferance of the public. Its stock is widely owned, passes from hand to hand, brings multitudes of men into its shifting partnerships and connects it with the interests and the investments of whole communities. It is a segment of the public; bears no analogy to a partnership or to the processes by which private property is safeguarded and managed, and should not be suffered to afford any covert whatever to those who are managing it. Its management is of public and general concern, is in a very proper sense everybody's business.

* * * So I take it to be a necessity of the hour to open up all the processes of politics and of public business—open them wide to public view; to make the accessible to every force that moves, every opinion that prevails in the thought of the people; to give society command of its own economic life again, not by revolutionary measures, but by a steady application of the principle that the people have a right to look into such matters and to control them; to cut all privileges and patronage and private advantage and secret enjoyment out of legislation.

Wilson recognized that the economic functioning of the business corporation differed from individually operated enterprise. In practice,

⁵ "Encyclopedia of American History," edited by Richard B. Morris, Harper & Bros., New York, 1953, p. 266.

⁶ "The New Freedom," by Woodrow Wilson, Doubleday, Page & Co., New York and Garden City, 1913, pp. 34-35, 132-133, and 134.

however, the "New Freedom" essentially proposed enforcement of competition in industry by more effective legislation. The Federal Trade Commission Act, designed to prevent unfair methods of competition, and the Clayton Antitrust Act, which supplemented and strengthened the Sherman Antitrust Act, were both passed in 1914. The Federal Reserve Act, passed in 1913, provided greater Government control over monetary policy, but the new legislation had not had time to prove its effectiveness before we were engulfed in a world war.

Depression of the Twenties; and Aaron Sapiro

The postwar depression of 1920 was sharp and short for industry, but persisted in agriculture throughout the entire decade. In the so-called new era of the 1920's, little attention was given to enforcement of competition or other regulation of industry. Farmers were caught with a high debt structure after a precipitous drop in prices of farm products. They sought new types of assistance in order to relieve the cost-price squeeze. With evangelistic fervor, Aaron Sapiro promoted the organization of ironclad cooperatives which were supposed to provide bargaining power for farmers similar to that possessed by business corporations. But the cooperatives had no control over output. The ironclad membership contracts with farmers broke down, and again the association approach did not fulfill its early promise.

High tariffs had been reinstated on industrial products by the passage of the Fordney-McCumber Act in 1922. Because farmers received little direct benefit from tariff legislation, they sought through the McNary-Haugen bill and the export debenture plan to make the tariff effective for agriculture. The McNary-Haugen bill was twice passed by Congress and vetoed by President Coolidge.

Congress passed the Agricultural Marketing Act in the early days of the Hoover administration (1929). This act created a Federal Farm Board for promoting marketing of farm commodities through Government-sponsored agricultural cooperatives and Government-financed stabilization corporations. This represented a new departure in Government assistance to farmers. The Government was no longer only an umpire; it was a player in the game. When these attempts at assistance failed during the depression of the early 1930's, it was only a short step to more direct Government participation in economic activity of farmers.

The Agricultural Adjustment Act passed in "the first hundred days" of the Roosevelt administration provided cash payments to farmers in return for voluntarily reducing acreage or products. Later legislation provided for support prices in return for adherence to marketing quotas, and for penalty payments by noncooperators. Thus, through agreements with individual opera-

tors for control of output in return for support prices, the Federal Government has become a participant with farmers in production and marketing of farm products.

Most of the Government activities undertaken to aid agriculture are in conflict with the enterprise creed as it was originally developed in an individualistic economy. So also are the steps promoting large-scale business corporations and nationwide labor unions. Each step, however, has been taken in response to urgent needs that were felt by large segments of the population. They harmonize with the democratic creed of majority consent. In fact, the legislation providing for these developments has usually been passed by substantial majorities. Agricultural adjustment legislation attempts to provide bargaining power for farmers which they have not been able to provide for themselves, functioning either as individuals or as associations. In this respect it adheres to Lincoln's philosophy of the legitimate object of Government.

Many conflicts of interest arise, however, even among different groups of farmers. For example, milk producers in the eastern milksheds tend to oppose controls on feed grain production as a violation to basic freedoms. Nevertheless, they favor restriction of sale of fluid milk to specific milksheds, and marketing orders with classified price plans for milk. Do such conflicts imply that

we usually do not object to Government activity when it benefits us as individuals, and provided it does not seriously interfere with our business operations?

Mixed Economy Developed

Unfortunately, many people do not yet fully understand the extent to which we have developed a mixed economy in the United States. With the rise of the business corporation, the later development of large-scale cooperatives, and the organization of labor unions for workers, the bulk of our economic activity in this country has shifted to the associationistic mode of economic functioning.

It seems evident from the steps we have traced that Government activity has been largely confined to assistance and regulatory functions. Most people accept the need for some modification of both individual and association activity for the common good. We do, however, have many unresolved problems both in agriculture and in other industry.

We need a reconsideration of the basic questions: How can we improve the organization of farming to combine abundance for consumers of farm products with prosperity for farmers? And how can we improve the organization of the business corporations and labor unions better to serve the public as well as the private interests?

Discussion—Continued

Walter W. Wilcox

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DR. BREWSTER has given us an excellent insight into the basic beliefs upon which our rural society was built in the premachine age. He has indicated that these continue to be the dominant and motivating beliefs of our society at the present time.

He did not stress as much as he might have the inherent conflicts among these beliefs in a highly industrialized, complex, and interdependent society. It was implicit in his discussion that in the premachine age most people weighted their conflicting beliefs somewhat differently than do most people in our current society. It is also implicit that rural people have modified their beliefs over the years less than urban people.

Against this background, and in view of the recent Supreme Court decision on the *Tennessee* case, I want to speculate a little as to how different our social and economic fabric might have been today if reapportionment in each State had been carried out as provided for in State constitutions.

My research leads me to believe that political scientists, while laminating the dominance of the

rural influence in State legislatures, have signally failed to specify why they lamented. They have failed to specify what inequities and injustices in society are the result of legislative action or inaction resulting from overrepresentation of rural people in legislative bodies.

Such studies as I have been able to find indicate that there is less difference than many assume at the present time between rural and urban attitudes and values. Nevertheless, I believe you will agree that over the past hundred years rural people have placed more emphasis on the beliefs of the enterprise creed, the importance of the freedom for the proprietor, and less emphasis on the beliefs of the democratic creed than have urban people. Rural people also have believed more strongly in the work ethic than have urban people, most of whom are employed by large impersonal corporations or by governmental units.

Rural People in State Legislatures

Starting from these assumptions, it appears probable that the overrepresentation of rural

people in State legislatures and in the Congress has resulted in delaying and minimizing State and Federal welfare legislation. Legislation strengthening the rights and improving the bargaining position of organized labor undoubtedly was delayed in time and weakened by the large rural representation in State legislatures and in the Congress.

It is less obvious—but probably also true—that in recent years the rural influence in the legislative halls has tended to delay and minimize legislation restricting the freedom of enterprise of corporations and businessmen. When monopolistic activities became flagrant—especially if they resulted in excessive prices for products purchased by farmers, as in the case of the “barbed-wire trust” at the turn of the century—rural people drew on their beliefs in the democratic creed and insisted on limitations on enterprisers (corporations) making and selling barbed wire and other steel products at monopoly prices. Rural leaders were in the forefront in enacting antitrust legislation and in the establishment of railroad regulatory bodies.

When the rural people were directly and seriously affected—as in the widespread use of discriminatory freight rates during the early years of the railroads—rural influence in the legislative halls took the leadership in limiting the area of private initiative and proprietary freedom of the corporations and individual enterprisers. Because of the greater weight given by rural legislators to the beliefs of the work ethic and the enterprise creed than their urban colleagues perhaps one has more commonly found them opposing or easing proposed restrictions on corporations and businessmen than vice versa in the past two or three decades. One author reports that business groups who are interested in maintaining the dominance of the conservative and antilabor point of view in the legislatures, increasingly are coming to the defense of rural overrepresentation.

Rural legislators are acutely conscious of the value of money and the difficulties their constituents have in paying taxes. Many, if not most, of their constituents would gladly take an urban job at the prevailing wage rates if they could find one, and would be happy with the governmental services available to them in the urban areas. From the point of view of rural legislators, about the only Government programs of sufficient value to justify increased taxes are national defense and programs which hold promise of increasing their constituents' incomes.

Large Urban Population; Large Tax Base

Agricultural colleges in States with substantial urban populations, perhaps because they have larger tax bases, appear to be more generously supported than those in States that have small urban populations. And it may be of interest to note that it was legislators from the industrial

States of the North who enacted the legislation establishing the institutions we are honoring in this series of meetings.

Throughout the decade preceding 1862, agitation for agricultural colleges and governmental assistance to farmers became increasingly vocal. Historians report that these moves were consistently opposed by Congressmen from the rural South who held strong views on States rights.

In 1862, however, the secession had removed from Congress the bloc of States rights advocates who opposed Federal farm aid. And it was under these conditions that the two great institutions we are honoring today were created.

In a number of States, however, it has been the influence of the rural legislators which was decisive in establishing State aid programs for public schools. Rural legislators armed with facts and figures on the inequity of financing public schools entirely from local property taxes have taken the leadership in establishing State income or sales taxes in many cases, and in financing a part of the local school costs from these new sources.

An editor for a large daily paper in the capital city of a rural Midwest State, however, on reflection, concluded that probably the most important adverse effect of rural overrepresentation in his State was the lag in the needed reorganization of the public school system. He attributed the failure to move faster in the consolidation of small school districts and in the development of curriculums better designed to fit the needs of the young people in his State to the strong rural influence in the legislature. Paradoxically, the failure to change school curriculums more rapidly has further disadvantaged and handicapped the farm young people and rural areas rather than helped them.

Turning to another field, State legislatures, overly influenced by their rural members, often have not permitted the large cities to initiate special taxes to provide special programs believed to be needed in the cities. In the Midwest State referred to earlier, it was 1959 before legislation was adopted enabling cities to participate in the Federal housing program.

The mayors and the councilmen in the cities, unable to get a sympathetic hearing in their own State legislatures, increasingly have turned to the Federal Government for assistance. The current urban-renewal program is only one of the results of this trend.

The late Senator Richard L. Neuberger, in his book, “Adventures in Politics,” cites his Oregon experience to explode the myth that it is the farm people who prevent reapportionment. When they finally got the reapportionment question on the ballot in Oregon, over the opposition of many smalltown politicians, the rural constituency voted 2 to 1 for reapportionment. He goes on to say, “I am convinced that rural politicians thwarting

reapportionment often are confederates of some of the most reactionary elements in their States. Vest-pocket constituencies are made to order for groups blocking social progress." The Oregon State Grange found that legislators from backwoods districts often served not their own constituents, but the financial interests which these rural legislators pretended to find so repugnant. In the words of the late Senator, "The farmers and the ranchers got the oratory; the banks and the utility corporations got the rollcall votes."

To the extent that the Oregon experience is duplicated in other States, the effects of the lack of reapportionment has been much greater than merely giving more weight to the beliefs of the enterprise creed and the work ethic and less weight to the beliefs of the democratic creed than would have occurred if, over the years, urban people had been equally represented in the legislative halls. However, it is not my purpose to attempt an assessment of all of the results that may be attributed to the underrepresentation of urban communities

in a rapidly growing and rapidly changing country.

Rural Influence Evaluated

If one were to summarize with respect to actual rural influence, the following conclusions appear warranted: Had the rural influence in the State legislatures and in the Congress been less in the past 50 years, it is probable there would be more government today. This is the single most important conclusion. It is probable there would be more welfare services, more protection for workers—especially in the States—perhaps even more regulation of corporations and businessmen, and more Government funds spent for conservation and public parks. More public roads funds would be spent in urban areas, and fewer would be spent on secondary roads. If the urban influence had been greater, State governments might now have higher salary scales, and almost surely would be stronger than they are today. But Federal assistance to cities would be less.

PANEL TWO

"Let me call them 'proofs,' " said Dr. C. A. Elvehjem, the principal speaker, as he outlined five fundamental developments in science as applied to agricultural progress. These five are:

- (1) "—that organized research can be a major force in the advancement of our society.*
- (2) "—that basic studies undergird application.*
- (3) "—that the application of research can be accelerated through well-organized communication channels;*
- (4) "—that the research team is an effective vehicle for complex projects; and*
- (5) "—that freedom is essential to productive research."*

THE EVOLUTION OF U.S. AGRICULTURE AS RELATED TO DEVELOPMENT OF SCIENCE AND ITS APPLICATION

Introductory Statement

Theodore C. Byerly, Moderator

Administrator, Cooperative State Experiment Station Service, U.S. Department of Agriculture

FROM THE TIME of first European colonization in North America, indeed, through many centuries of prior Indian inhabitation, the forest, ranges, wildlife, the soil, and water were used by man to meet his immediate needs. Often they were used exploitively; sometimes wastefully. As resources yielded less, man moved to new land—new frontiers. In 1862, President Lincoln wisely signed legislation that determined a new course in the use of resources. It said that man needed to make more effective use of existing knowledge in agriculture and to provide a basis for obtaining additional knowledge through experimentation and research. The act of May 15, 1862, creating the Department of Agriculture, and the Land-Grant Act of July 2, 1862, became the foundation stones

for later passage of the Hatch Act of 1887. Thus became assured in each State, and cooperatively on a nationwide basis, the establishment and support of research competence in the sciences relating to agriculture.

Increase in research effort and accumulation of research results have enabled us to conserve and increase the capacity of forests, ranges, cropland, and water, especially during the past 30 years. Research competence facilities and information constitute one of our major resources for the future. They assure the Nation's capacity to meet the foreseeable needs of its future population for forest products, for open space, for rural living, for industrial, recreational, and wildlife needs, as well as our needs for food and fiber.

The Evolution of U.S. Agriculture as Related to the Development of Science and Its Application

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IT WOULD BE possible to spend my allotted 40 minutes on a litany of agricultural science developments over the century of progress we are marking today, and still be forced by time limitations to leave unmentioned many of the most important.

So swift has been our progress, so fundamental the change, that the word "agriculture" today bears little resemblance to its definition a century ago. And much of the change can be traced directly to scientific research and its applications.

The change that science has worked through deepening our knowledge of the soil and weather, plants and animals, production and marketing, and our understanding of people has not only completely transformed agriculture in this 100-year span, but in this transformation has affected almost everything else we do, and all of us.

Because the sweep of change has been so broad and deep, I propose to confine my discussion today to a single segment, though even such arbitrary narrowing will not allow exhaustive exploration of the segment. It has the virtue, however, of enabling me to talk about an area with which I am most familiar.

I propose, then, to list five of what I consider the fundamental developments in science that have come out of our research, over the century, and show, by example, the part that agricultural goals have played in them, or the part that they have played in agricultural progress.

When visitors from abroad come to the United States to learn how their nation can quicken progress in agricultural development—particularly in food production—they usually are thinking in terms of taking back with them the improved farm practices which our scientists have helped to develop.

To my way of thinking, these fruits of our American research and technology are nowhere near as essential to another country as is the pattern of public support in America for the basic education of everyone, advanced training for those especially gifted, the encouragement—including public financing—of basic research and its application to crop and livestock production to fit the specific needs and requirements of each area or region, and the wide dissemination of the information coming out of this research.

Out of Our Search

These developments which I have chosen to discuss are not discoveries in the normal sense—like new crop varieties or nutritional properties—but, rather, principles that have evolved out of our search for such things as new plants, or have proved themselves in helping us unlock nutritional knowledge.

Let me call them “proofs.” And here are the five I would like to discuss:

First, that organized research can be a major force in the advancement of society;

Second, that basic studies undergird applications;

Third, that the applications of research can be accelerated through well-organized communications channels;

Fourth, that the research team is an effective vehicle for complex projects; and

Fifth, that freedom is essential to productive research.

That organized research could be a major force in the advancement of society, my first point, is

an idea at least as old as the Massachusetts Agricultural Society, which, in its petition for corporate powers to the General Court in 1792, set forth its aim at improving agriculture through experiments. It was propounded also by the Albemarle Agricultural Society, as conceived by Thomas Jefferson, to obtain “A succinct report of the different practices of Husbandry in the district inhabited by the members” on the theory that “the choicest processes culled from every farm would compose a course probably near perfection.”

The role of government in this process was foreseen by George Washington who, in his last annual message to the Congress in 1796, called for an agricultural board “to encourage and assist a spirit of discovery and improvement.”

Many years were to pass, many struggles were to come, and with them many disappointments and new starts, before the proof of the soundness of these ideas came in the development, mostly in State and land-grant universities, of that pioneering tool for social progress, the agricultural experiment station.

For, despite the words of Washington, Jefferson, and the other early visionaries, implementation was slow to develop, almost had to be forced, step by step, by the farmers and their organizations. It was to one such organization, the Wisconsin State Agricultural Society, that Abraham Lincoln, in 1859, admitted the recurring thought that “every blade of grass is a study. To produce two where there was but one,” he added, “is both profit and a pleasure.”

And, as you well know, in his first annual message to Congress, he called for “an agricultural and statistical bureau,” and, within a year, that body created in the Federal Government the Department of Agriculture, whose Centennial we mark today, passed the Homestead Act, and the Morrill Act, a legislative series which started our Nation toward the organized application of scientific research to the problems of the farm.

Beyond Food and Clothing for Himself

Our American concept of the family-type farm had its governmental endorsement in the Homestead Act. The Morrill Act recognized agriculture as a science and art fit for the highest scholarship. The Department of Agriculture symbolized the determination of our Nation to free man from the all-consuming chore of feeding and clothing himself for additional pursuits that could lead to the good life.

That the application of the scientific method to agricultural improvement was a purposeful move toward making research a tool for social change is evident in almost everything that was said in the promotion of such programs a hundred years ago.

The regents of my own institution, for example, declared in 1850 that study and research could

raise agriculture "to the dignity of a profession," make it "stand not only in the front rank of the experimental arts, but side by side with the learned professions in interest and honor, as well as in profit."

Historian Vernon Carstensen, from whose papers I have taken much of the historical material cited, has pointed out that the experiment station development in our Nation, with its close and intimate connection with the Department of Agriculture, represents not only "a unique achievement as a national cooperative research establishment supported by State and Federal funds," but also an example "of how organized research could be conducted."

Economist Harold M. Groves has cited agriculture as an example of the "potentialities of outlays made purposefully to develop knowledge," and has described the result as "a chemical revolution on top of a biological revolution on top of an engineering revolution."

Let me summarize briefly what that has meant to our Nation.

We have found that well-nourished, healthy people have a better chance to improve their material and cultural welfare than those who are hungry, who are threatened with illnesses on every side, and whose average length of life is only 30-35 years, or half that in the United States today. People whose labor brings them an income which is more than enough for the bare necessities of life are likely to be better citizens. And those who need to work fewer hours in gaining a living wage have the chance to devote more time—if they wish—to cultural pursuits which our society deems important.

Food today in the United States takes a smaller share of the workingman's dollar than in any other country. Yet food here is better in quality and greater in variety, as well as more plentiful, than it has been anywhere else at any time in history. This is made possible by a agricultural industry which employs only 10 percent of our work force on the land, as in contrast with 45 percent in the U.S.S.R., and even a larger percentage in many countries.

But the contributions of agricultural science to the welfare of our people have extended far beyond matters of food production and supply.

Endless Frontier Opened

Perhaps its greatest long-term, overall contribution was opening, for us, what Vannevar Bush terms "the endless frontier" of science.

There can be little debate on the point that the success of research in agriculture pointed the way toward what Economist Sumner Slichter now calls the "industry of discovery," the conviction that our economy, our Government, our society, and our very lives can be changed by organized research efforts. The experiment stations proved the point so well that governments, foundations,

and industries today are making massive investments in research to bring about change. And while, as the historian, Henry Steele Commager, has said, "change does not necessarily assure progress," it is quite clear, as he added, "that progress implacably requires change."

My second point, that basic studies undergird applications, was not—as far as I can tell—in the minds of those who a century ago so foresightedly implemented agricultural experimentation. In fact, there is strong evidence that while the search for knowledge for searching's sake was then gaining some headway in our universities, it was not intended that any such foolishness would be allowed in the agricultural experiment stations.

The idea that basic studies could implement instruction in our universities came to us from Europe along with many of the other early forms and features of our institutions of higher education. It was fortunate, then, that the thrust of agricultural research was lodged in universities, for they were the only possible early proving ground for the principle we accept today.

If I may be excused for picking homegrown examples in a field where examples everywhere are evident, I would like to describe how basic research and applications developed side by side in the University of Wisconsin.

I believe it was from Johns Hopkins University, founded in 1879, that Wisconsin inherited the German concept of university research—the careful and thorough investigation prompted only by the scholar's curiosity and desire to know as much as he could about what he was teaching. It is possible to link this infusion into Wisconsin academic life to a single name, Richard T. Ely.

For that matter, the concept of organized applied research also can be associated at Wisconsin with a single name—Stephen M. Babcock, who in 1890 announced the invention of a simple, quick, and accurate device to determine the butterfat content of milk, a discovery that gave early stature to the applied research in our agricultural experiment station.

But it actually was the intermixture of these two types of research—and I am quick to say that it often is difficult to draw a line between them—which made the Wisconsin Agricultural Experiment Station so successful.

The attitude that grew here was best expressed in the words of E. B. Hart, one of the station's great pioneers, "that the station worker, in cooperation with the station director, take a practical farm problem of importance in a local region or State and then dig as deep as he can in science in order to find the answer to the problem."

Great Veins of Knowledge

It soon developed that Wisconsin workers, under such procedures, dug with such vigor that they often forgot the problem that prompted the digging and uncovered great veins of knowledge

which, incidentally, solved other and sometimes more critical problems.

As some of you may know, Wisconsin's contribution to the knowledge of nutrition was just such a situation. Babcock had come to Wisconsin from the Geneva, N.Y., Experiment Station, and had brought with him a disturbing conviction gained in his experiments there in feeding cows and analyzing the feces. He had discovered that the conventional chemical methods of evaluating feeds did not explain the utilization of food by animals.

Professor Hart, whom I quoted a moment ago, was one of the Wisconsin scientists who carried on the investigation to the point that controlled experiments proved there were elements in food which could not be identified by chemical test. I suspect that the only resemblance to applied research in Hart's work was the fact that he used calves as experimental animals. But even this meager identification was soon to be shattered. E. V. McCollum, who came to Wisconsin in 1907 and left for Johns Hopkins 10 years later, has told of his establishment of the first rat colony in these words:

"When I told Dr. Babcock about my plan," McCollum recalled, "he responded enthusiastically, and without delay took me to the office of Dean H. L. Russel to lay the project before him. When I had related my thoughts about the merits of the problem and of using rats as experimental animals, he dismissed the suggestions as unacceptable for two reasons: In an experiment station we should devote our efforts to the study of farm animals; (and second) the rat was a pest, and if it were to get abroad that we were using Federal and State funds for feeding rats we should be subjected to severe criticism.

"But Babcock was undaunted by the dean's adverse decision," McCollum reported. "He told Hart that he wanted me to have permission to carry out my plan, and on his insistence my chief gave me permission to do so. So far as I know," McCollum said, "Nothing was said about the matter to the dean, and the undertaking was not made a formal project, a procedure which I am sure is occasionally made good use of today."

Contrary to McCollum's thought, there is no need today to avoid reporting basic studies in our agricultural experiment station—or perhaps in any other. The conviction that basic research undergirds applications is universally accepted.

I like to think that the Wisconsin nutritional studies played an important role in this change. The elucidation of the chemistry of carotene and vitamin A added to our knowledge of organic chemistry; study of the mechanism of the conversion of carotene to vitamin A in the animal body opened new vistas in biochemistry and physiology. The identification of the need for such trace elements as iodine in human and animal foods inspired us to make many subsequent transfers of animal nutrition discoveries to the field of human health and preventive medicine.

Another Landmark

Harry Steenbock's demonstration in the Wisconsin Experiment Station that vitamin D could be supplied to animals by direct irradiation of ultraviolet light was another landmark of such transfers, virtually eliminating rickets as a human ill, and similar maladies in farm animals.

My personal experience in agricultural research demonstrates, perhaps as well as anything else, how the freedom of basic research had been assured in Wisconsin's Agricultural Experiment Station by the time I had entered its laboratories, and how applications develop from such free-ranging studies.

I can honestly say that in 35 years of research in that station I had complete freedom to study what interested me.

For my bachelor's thesis I worked under Dr. Steenbock in an attempt to isolate the pigment from buckwheat which caused sensitivity to light when consumed by certain animals—a study we undertook with no inkling that it might be practical. The first year of my graduate work involved studies of the effect of ultraviolet light on calcium balance in the milking goat. I can assure you that the goat was never considered an important Wisconsin farm animal. Actually, the only practical result there was publication of my first scientific paper in the *Journal of Biological Chemistry*—and that was as much a disappointment as a triumph, for my work was condensed into two small tables.

Later, my studies ranged into vitamins A and D, and into the part that copper plays with iron salts in eliminating the incidence of thumps in suckling pigs and anemia in growing infants. In this instance the investment of time and money paid ample agricultural dividends, but if we had not already established the value of basic studies one could not have expected the director of an agricultural experiment station to show much patience while watching us cut off the ends of rattails to make hemoglobin determinations, or ash cabbage and lettuce to see what mineral we might find that could supplement iron in hemoglobin production.

Under such conditions, an agricultural experiment station director would have been even more distressed, a little later if he had come upon us in our attempts to ruin perfectly good animal rations by various treatments. We found, for example, that when one natural ration was heated under moist conditions and fed to laboratory animals, we obtained the typical symptoms of beriberi, and that if this same ration were tested dry at a temperature of about 100° C. and fed to chicks, the chicks developed a very characteristic type of dermatitis.

Now we had no desire to harm chickens, and the illnesses we imposed were not problems common in chicken culture on the farm. But the dermatitis interested us as a possible manifestation in

chickens of what in man was called pellagra, a growing health menace. The first case observed in the United States was in 1863, and by 1912 we had 30,000 cases with 40-percent fatality. Most people thought it was an infectious disease until Dr. Goldberger demonstrated that it had its roots in nutritional inadequacy. If his demonstration was as sound as we thought it was, and if we had, in fact, produced pellagra in a laboratory chick, the isolation of the antipellagra factor would be a good research subject, and I decided then and there to undertake the study.

However, my plans were interrupted because about that time I was given a National Research Council fellowship to study in Cambridge, England, and, by the way, this is another example of the attitude of our administration regarding basic research; allowing me to leave the station for a year to work in a biochemistry laboratory that had no relationship to agriculture or farming.

During the year I spent most of my time in the area of enzymes and the possible relationship of vitamins to enzymes. It was an experience which allowed me to return to Wisconsin to work in this most intriguing field, one which is still attracting a great deal of attention.

But during that period I had another fortunate experience. I had taken along some liver extract which we had used in our iron and copper studies in the hope that I might find some use for it in England. I did not find such use, but a visiting Indian student who was working on the vitamin B complex borrowed a small sample from me and after a few weeks he was extremely excited because this material was the richest source he had found for the B vitamin he was studying, which later turned out to be riboflavin. So when I returned to Madison in the fall of 1930 my problem was all arranged for me. I had experimental animals for assay purposes, and I had a rich source of the vitamin B complex.

The next 7 years were a period of much work and oftentimes many disappointments, but by 1937 we were able to announce that the active principle in liver extract was nicotinic acid, and within a few weeks Dr. Tom Spies showed that nicotinic acid was an effective agent in the treatment of human pellagra.

This was a significant contribution to medicine, but what did it have to do with an agricultural experiment station?

Even more confusing was the fact that when we tried pure nicotinic acid in the treatment of the dermatitis which we had observed in chickens it failed to work. We soon found that the active substance was pantothenic acid, another vitamin that had been concentrated along with nicotinic acid.

Pantothenic acid is of real significance in poultry nutrition, and with the availability of nicotinic acid and pantothenic acid it was possible to devise purified rations which could be used for work on

still other B vitamins, such as vitamin B₆, folic acid, and biotin.

And Now the Payoff for Agriculture

Here, we had come the full round. Basic studies—systematic exploration of the unknown—had been brought to the point in this agricultural experiment station, where they could, in fact, be applied to agriculture.

Of course, they also set us off on a new round of fundamental work, which ultimately benefited agriculture in another way. But I will bore you no more with personal narrative. Suffice it to say that I can testify to the fact that basic studies undergird applications, and that it was in the agricultural experiment station that this was proved beyond all doubt.

My third point, that the applications of research can be accelerated through well-organized communication channels, was demonstrated most conclusively as a result of another agricultural landmark, the Smith-Lever Act of 1914. In retrospect, this has probably proved as significant, in the application of science, as the Hatch Act of 1887 was in generating research in the agricultural experiment stations.

It was the Smith-Lever Act which established agricultural extension work as a cooperative endeavor of the Department of Agriculture and the various States and counties, to take the fruits of science into the countryside.

Prior to this, the experiment stations and the Department of Agriculture were using various means of getting the results of their research into the hands of farmers—publications, meetings, and similar methods. Some States even had established the prototypes of the county agricultural agent.

But Federal recognition that discovering better farm practices was only half the job, and the development of an effective system to complete the cycle, were the contributions of the Smith-Lever Act.

Henry Wallace, recalling feeble efforts at agricultural extension before the passage of the act, has told of attending an Iowa short course 58 years ago. "The college people had not yet learned very successfully to bridge the gap between science in the laboratory and practice on the farm," Wallace said. "I learned that because I sat with farmers and heard what they had to say."

E. R. McIntyre, writing of these days from the agent's point of view, recalled that he "circuit-drove" a horse and buggy or a dusty old Ford, loaded to the gunwales. "Somehow," McIntyre reported, "he tucked in and toted soil augers and soil samples, wire seed corn racks, packets of litmus paper, ragdoll seed germination rolls, dairy barn record sheets, caustic potash and nippers for calf and cow dehorning, dynamite sticks for ditch and stump blasting, drain tile samples,

spray guns, balanced feed guides, hip boots, and formaldehyde for treating seed grain. And in college bulletins, bundled up with binder twine, the Extension worker carried handy plans for bullpens, milkhouses, and split-log road drags."

Extension Idea Takes Root

Although these men "peddled progress," McIntyre wrote, it was small wonder that "some skeptical farmers classed them with itinerants—tinware and notion merchants, liniment and extract salesmen, and the ubiquitous specialists in lightning rods."

And they made plenty of mistakes, McIntyre admitted. "Too much was expected sometimes. Extension livestock agents found themselves asked to answer profound questions on economics, and poultry demonstrators might be called upon to dock and castrate lambs. . . . When the county agent opened his bag of tricks on each farm, it was often to do personal-service jobs. Veterinarians complained about professional work done free. Local merchants howled when county agents recommended home-mixed rations."

Yet, as McIntyre has revealed in his 50-year history of agriculture extension, it was just such personal services by devoted people, with the help and guidance of centrally directed Extension Service, that won confidence for the agricultural agent and became the key to communicating agricultural research findings to the barnyard.

Through the fieldmen for "agribusiness" today, the modern agricultural advisers, now women as well as men, "are far removed from the early beginners—as far as the sleek, powerful, streamlined motorcar is from the limping lizzie," using television, radio, farm journals, motion pictures, and all the current communication media and techniques, the personal touch remains the key to motivation in farm change, and the county-agent system remains the most effective method of applying scientific knowledge that man has devised.

A year or so ago the General Motors vice president in charge of research, Dr. Lawrence R. Hafstad, interested himself in the timelag between discovery and applications of some of mankind's developmental benchmarks.

He found that the idea of photography, conceived in the 1720's, took 112 years to reach commercial use. Telephone, discovered in the 1820's, took 56 years. Radio, born in the 1860's, took 35 years, while television, an idea in the early 1920's, took only 12 years to reach the market.

While the whole area of communications improvement, involving sales techniques, advertising, and the mass media can be credited for the decreasing lag, much of what we know about the utilization of these channels to speed the adoption of change came from our experience in agricultural extension.

Applying this knowledge to farm improvements in the two decades from 1930 to 1950, when the

amount of cropland did not change appreciably, we doubled the utilization of implements and machinery, and tripled the purchases of fertilizers. Cotton production jumped from 235 pounds per acre to 409; corn from 27.7 bushels to 51.7; peanuts from 762 pounds to 1,205; and burley tobacco from 833 pounds to 1,567.

The widespread adoption of hybrid corn seed, as soon as its cost became reasonable, was perhaps the outstanding example of the effectiveness of modern communication techniques, and, according to T. W. Schultz, of the University of Chicago, provided a social return on the investment in its development approaching 700 percent.

Extension Shifts With the Times

As President James H. Hilton, of Iowa State University, has pointed out, the concept of extension education has vastly changed since its beginnings.

The educational problems with which extension services now deal have spread out from such demonstration services as dehorning cattle, culling chickens, or pruning fruit trees, into a bewildering array of farm and home management problems, problems in family living, community problems, and the economic problems of agriculture and public farm policy. Our cooperative extension services now see the farmer not only as a producer and his wife not only as a homemaker, but recognize them as total persons with broad social, civic, and esthetic interests.

And I might add, in passing, that the technological, economic, and cultural changes which agricultural extension has played so large a part in bringing about have now thrust new major challenges at our extension system which will force many changes in it, in the years just ahead.

My fourth point, that the research team is an effective vehicle for complex projects, was demonstrated so conclusively in the development of atomic energy that it no longer needs defense. Yet there is a strong inclination in the gray heads among us—my own included—to look back nostalgically to the good old days when a single scientist, working in the loneliness of his own mind and his own laboratory, and with a few simple tools, could make a major discovery.

This is not to say that, even in today's broad exploitation of team research, individuals do not make major contributions. The annual award of such recognitions as the Nobel Prizes is testimony to the fact that the single, crystallizing idea which underlies major advance usually can be traced to a single mind.

But the proof of the idea, and its application to mankind's problems—the general area in which we are concentrating our discussions in this meeting—now usually require organized team effort. Some of the research examples I cited earlier illustrate the basic unity of knowledge—how a fundamental finding in agricultural research has been applied to another area such as medicine.

But even with studies well within a traditional area of knowledge the team approach often is the most effective. Let me give you an example of team studies that range across the face of the earth, with the aid and direction of the U.S. Department of Agriculture. I speak of current potato-breeding work.

As you may know, potatoes from foreign lands are not suitable for our commercial production in the United States. But they sometimes have many good qualities which would be desirable in the potatoes which we cultivate in this country. For example, a potato species which grows high in the mountains of Mexico thrives at the snowline and is not injured by temperatures as low as 18° F. Another Mexican potato grows strong and green under conditions where most varieties would quickly wither away because of late blight; still others contain insect repellents or natural insecticides in their leaves; and many from Central and South America carry resistance to various diseases. There is a wealth of genetic material in these foreign species which is potentially valuable to potato producers in the United States. The potato lost a lot of good qualities on the long trip from its South American homeland to North America's dinner table. Now our potato breeders are looking to Latin America and other areas for breeding material that will improve potato quality and make them easier to grow.

The first step in this, of course, is to find the species or varieties which have something to offer. This is the task of that hardy breed of scientist, the plant explorer. Most active of these in the potato-breeding programs has been Donovan S. Correll, of the U.S. Department of Agriculture's Division of Plant Exploration and Introduction. By jeep and mule, he and others like him have combed the mountains and plains of Central and South America to collect wild potatoes. The species found by the explorers are then sent to a central repository, which is located in the northern part of Wisconsin in isolation from serious disease and insect problems. Potato breeders from other nations also supply materials to this "potato zoo." The wild potatoes and foreign varieties are multiplied and maintained, and made available to potato research men all over the Nation who would like to use them in breeding work.

So here we have U.S. Government of Agriculture scientists supplying specimens to a facility maintained jointly by the Wisconsin and other State experiment stations and the U.S. Department of Agriculture, and operated by men employed jointly by the cooperating agencies. They are doing the hard, and sometimes routine, job of screening, increasing, and preserving a source of germ plasm for other scientists to use in developing new varieties—an important, and indeed essential, service which may later be acknowledged only in passing when another scientist uses this

carefully selected genetic material in developing a new commercial variety.

The actual evaluation of the qualities of these wild potatoes is done by scientists in experiment stations all over the Nation who are interested in breeding specific qualities into commercial varieties adapted to their local soils and climate.

Recently, for instance, Florida scientists found that a Dutch potato resisted a soilborne virus disease called corky ring spot, which is very hard to control by cultural practices or chemicals. Idaho and Washington research men reported that two German hybrids proved highly resistant to leafroll virus. Minnesota researchers found several additional sources of late blight resistance in Dutch and German varieties. Iowa and Ohio potato scientists found resistance to flea beetles and leafhoppers in a South American species and in some common hybrids. New York scientists report progress in transferring resistance to golden nematodes from South American potatoes into our present commercial varieties. At Louisiana, scientists are finding that a couple of foreign varieties give potatoes with a very high dry-matter content.

Would this kind of progress have been possible if each scientist had to obtain his own breeding material from the Andes Mountains? Or if the people at the potato introduction station in Wisconsin had to conduct all the evaluation and breeding work? The complex job was split up among many people, and it is being done with efficiency and dispatch. American consumers, and eventually potato consumers throughout the world, will benefit from this carefully planned, and efficiently organized, cooperative program of research.

My fifth and final point—that freedom is essential to productive research—is an idea sometimes challenged today, with Russia as an illustration.

Russia's rocketry lead, the argument goes, illustrates that centrally imposed discipline can move research and application swiftly into areas of interest. This we long have known, and in some respects, we, too, have utilized this technique in agricultural research. But we have tempered our drive with freedom, and it is my conviction that our national standard of living, our extension of the average lifetime, our ability to move forward across the full scope of knowledge, are the results.

When a farmer brought a dead cow and a pail of blood into the agricultural experiment station laboratory of Karl Paul Link, it was Dr. Link's freedom to search beyond the immediate need for cause and cure of a specific problem that led to the development of our most potent rat poison and to an anticoagulant of great merit in medicine. Had this research team been limited to solving the problem of the cow, the world would have been without two great applications.

The freedom essential to research is double headed: freedom to investigate and freedom to

publish. Restriction of these freedoms in commercial laboratories and exploitation of these freedoms in university laboratories can be compared here on our own soil, and such comparison cannot help but lead to the conclusive proof of freedom's effectiveness.

The Morrill Land-Grant Act, whose centennial we celebrate this year along with that of the Department of Agriculture, proved to be the mechanism that guaranteed freedom in agricultural research by lodging much of it in the universities.

Under the impetus of the Land-Grant Act, research in the agricultural sciences grew, and with it developed a whole new breed of men—dedicated to the advancement of knowledge, training successors in their fields, and employing the scientific method to solve the problems of the land.

Like all freedoms, the freedom of an experienced and productive research worker to be something more than a skilled employee doing the bidding of his employer carries with it a large responsibility. He must, first of all, be willing to acknowledge his basic obligation to put the public interest ahead of partisan or personal interests.

He must be alert to new developments and new needs. When the general public becomes anxious about a problem, the demand is for action, even though there may be serious gaps in the information on which action should be based. The foresighted scientist sees a problem in his specialized area before it becomes obvious to the general public, and makes an appraisal of its potential importance. When the facts indicate the need, preliminary inexpensive studies are initiated. By the time the public becomes concerned, much essential information is already assembled, and a start has been made on exploratory studies to supply the most needed new knowledge. This ability

to choose wisely the next area of investigation which, all things considered, offers largest promise to a particular scientist, is one of the most valuable attributes a research worker can possess.

Most scientists who have won recognition as successful investigators have this talent.

The most important function of the research administrator, in my judgment, is to make sure the new people added to the staff have the competence to use wisely the freedoms and opportunities which should be the possession of project leaders in every good research laboratory. Directors of research are successful largely in terms of their ability to select and hold onto really competent scientists who continue throughout their employment to grow in their capacity to plan and to conduct research. Good research people do not need, and are not helped, by research administrators who seek to "direct" research. Less competent scientists cannot be made first-class investigators, even when a research director tries to help them. It is rare to find today any second prizes in research, regardless of the form they might take.

These, then, are some of the lessons we have learned in a century of agricultural evolution related to science and its application:

—That organized research can be a major force in the advancement of society;

—That basic studies undergird applications;

—That organized communication channels can speed the applications of research;

—That team research is an effective tool for complex projects;

—And that freedom is essential to productive research.

Of these five, the last stated is most important. Give us freedom to inquire, and the answers will be found.

Discussion

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PRESIDENT ELVEHJEM spoke of five principles as underlying the great progress in food production and improvement of food for men and animals. I repeat the first two principles here with slight variation for the sake of emphasis and clarity in discussion. The principles are:

First, organized research was a major factor in agricultural development during the last century. An addendum to this principle is: The potential for accomplishing desired ends as the fruits of past research is now very high, current progress is great, but the promise for the future needs attention.

I would like to emphasize the early importance of the agricultural experiment station and the U.S. Department of Agriculture in establishing centers for research and experiments in technology when the values of these approaches were neither widely known nor accepted. The concept of advancing knowledge was instilled as an essential factor into agriculture, and from agriculture's support it spread into the technology of the Nation.

Oliver C. Carmichael, former president of Alabama University and the author of *Graduate Education*, recently wrote:

Undoubtedly the scientific, technological, and technical development of the past 100 years has been largely due to the emphasis on science and technology in American higher education which, in turn, stemmed largely from the land-grant-college movement.

Through research in agriculture the idea of status in quo was dispelled: the acceptance of the present condition as satisfactory. The eternal "itch" for change—for something new—became the driving force of the Nation, with research as the leading force for the change. New car models appear every year and the methods for handling grass scarcely resemble those of 10 years ago.

The Next Century

Our appreciation of accomplishments of the last century, a time during which the Nation changed from an agricultural to an industrial one, should not dim our vision for the demands of the next century. The success of research and the ability of management today continuously decrease the fraction of the national effort needed in agriculture. The schools of agriculture, the source of research personnel and potential, are relatively smaller parts of the land-grant-college activities. But the demands on research effort are great in a highly organized agriculture. Today use of water, land, plants, and animals—the totality of food production—is competing with continued urbanization. Competition on even terms demands improvement for survival of a healthy agriculture.

Professor Elvehjem's second principle, quoted without change is—basic studies undergird applications.

He spoke of E. B. Hart's advice to a station worker, "... take a practical farm problem of importance in a local region or State and then dig as deep as possible in science to find the answer to the problem."

This is basic research, the appreciation for which is now very high.

President Elvehjem has devoted much of his life to basic research. I also have, and can affirm with him the value of E. B. Hart's advice. In basic work the method is to search as deeply as possible for causes, and the starting point for many of us is in practical problems that we might serve the social purpose of producing two blades of grass where there was but one. The "profit and pleasure" of which Abraham Lincoln spoke are the reward of basic research, the reward of understanding things that were not previously understood, no matter whether they be great or small.

The Immense Unknown

In agriculture we face not only many problems of technology and production but the still immense unknown of all living things—the understanding of the way living things function. We strive to understand photosynthesis as the initiating step

of the food chain, from plants to animals to man. We seek the nutritive requirements of man, animals, and plants, and in the course discover all of the vitamins. We tried to understand the lump on the throat of a woman as well as a pig on a Wisconsin farm far from the sea and come to know of iodine and goiter. Now we have iodized salt. We try to understand a disease, or the resistance to a disease, and modify man's whole future as Theobald Smith did in the last century when he found transmission of Texas fever by the tick. Cattle have now been dipped or sprayed for so long as to lead one to forget the scrubby beast that once roamed the plains.

In part, these are things of yesterday, of the first 75 years of the past century. The findings of research, as President Elvehjem has emphasized, are accepted and molded into the society. Efforts devoted to betterment and change are no less intense today. Two unforced examples drawn from the last 10 years might suffice to illustrate striking current successes in agriculture. G. W. Burton, in Tifton, Ga., by the breeding and introduction of coastal Bermudagrass, has afforded a base for modifying the agriculture of the entire southeastern and southern region by improvement of pastures, not by a small factor but by a multiple in yield or the number of animals that can be carried on a acre. E. F. Knipling, in charge of entomological research of the U.S. Department of Agriculture for 25 years, held that the screwworm fly that lays its eggs in open wounds of animals could be controlled through biological understanding of the effects of high-energy radiation on its fertility and reproduction. Through these efforts the screwworm fly is eliminated from the Southeastern United States, where it caused much loss in livestock. Not reduced, but eliminated—not a single fly remains. The more formidable task of control in southwest Texas is just starting.

Where Curiosity Is Fostered

In elaborating on this one of President Elvehjem's principles, I have drawn on sources within the United States. But, as he pointed out in his fifth principle, agricultural well-being and increase of basic knowledge are possible where curiosity is fostered and where the freedom to search is preserved. We can turn to Australia and New Zealand for several striking examples in which knowledge of the cause profoundly affected the economies of those nations and improved their high standards of life. The poor productivity of vast land areas in Australia was finally traced to deficiencies of a few minor or trace elements necessary for plant growth. A most striking one of these is molybdenum, without which the clover and other legumes necessary in good pastures will not grow. The lack of molybdenum can now be met by use of about an ounce per acre, not only in Australia but also in the San Joaquin Valley, in Florida citrus groves, and on crops of cauliflower on

Michigan farms. In New England, a wastage of animals, after diligent research, led to recognition of cobalt as an essential element in animal nutrition. A cobalt-deficient area is present in New Hampshire, an area in which something was appreciated as wrong by the rough coats of the animals even in colonial times. Cobalt finally was identified as a necessary part of vitamin B₁₂ which was discovered simultaneously to be a growth factor for chickens and man. Harold Evans, working in the Oregon State University Laboratories, currently is finding that both cobalt and molybdenum are needed for nitrogen from the atmosphere to enter the cycle of life (Nature, Apr. 7, 1962).

Finally, further to illustrate something of the attitudes and productivity of basic research, I will turn to Taiwan or Formosa as it was then known—to illustrate freedom of thought and exercise of curiosity. On Taiwan and in many other areas of the East, there is a disease of rice known by the Japanese word "Bakanae," which causes plants to grow tall and thin. This disease, which has been known for centuries and which once had been suggested as coming from opposed aspects of Buddhist philosophy, was recognized as early as 1898 as being caused by growth of a fungus. Some measure of control, based upon sanitation, resulted from his knowledge. But curiosity as to how the growth change of rice took place was still deep. The agronomist, E. Kurosawa, starting in 1926, finally proved the transmission of the disease by a fungus that produced an active chemical. Other Japanese workers isolated and studied the responsible compound. Appreciation of the quiet

and dedicated work of these men was first evident in the Western World in 1950. Since then the active compounds, now known as the gibberellins, have been widely studied and are appreciated as markedly effective controlling agents of plant growth. They are coming into use, first to increase the enzymatic activity in sprouted barley in beer making and to loosen up clusters of grapes.

In closing my discussion, I would like to turn slightly from President Elvehjem's address and emphasize, as he undoubtedly will accede, the incomplete status of our knowledge—the still unworked mine of our opportunities in agricultural production and use of agricultural products. A single illustration will suffice from among many possible ones. The manner of action of most vitamins is either completely unknown or only sketchily realized. In what way is the cobalt of vitamin B₁₂ effective? I am sure that President Elvehjem would like to know more about the way in which vitamin D acts to regulate the use of calcium in the body and would like to understand more fully the causes for success of Professor Steenbock's ultraviolet irradiation process of milk, a success that underlies so much of the potential for research of the University of Wisconsin. He might like to return to the way in which copper and iron interact in anemia and again try to learn how the body uses copper to mobilize the iron. And surely none of us yet safely knows what might be the cause of muscular dystrophy in man or the white muscle disorder in animals. I will not torture him with what he foregoes in personal accomplishment and satisfaction as he serves others in a wider and social capacity.

Discussion—Continued

Charles Glen King

President, Nutrition Foundation, Inc.

DR. ELVEHJEM has presented an excellent account of the revolution of agriculture in the United States, as related to science and its application. Despite his relative youth, he has had three great advantages for the task—first, in having been associated almost constantly with some of the greatest research pioneers whose lifespans, joined with his own career, cover most of the entire century now under review.

Second, he had the privilege of working steadily in a great university that combined the land-grant-college concept within a total university environment that made it one of the greatest institutions of its kind in the Western Hemisphere.

And third, but most important of all, he has himself been recognized as one of the foremost scientists of his generation in agricultural research and education.

The five principles that he has stated and illustrated clearly within the history of the University

of Wisconsin can be accepted, I believe, as basic in past experience and will serve as guideposts for the centuries ahead.

There can be no doubt, surely, that the land-grant-college system, as it has developed in the United States, has been one of our greatest resources for total scientific, economic, social, and cultural development. The record as a whole has been phenomenally good.

However, since very few colleges or universities have attained records that are comparable with that of Wisconsin, perhaps it is well to consider some of the reasons for starkly lesser accomplishment in other institutions that were established for similar purposes.

It goes without saying that many States failed to provide financial support that was adequate for reasonable progress—in part this situation resulted from very limited economic resources within the State, but other reasons also intervened.

An Unintentional Handicap

Many States retarded their land-grant institutions by putting them apart from the more classical State universities and thus robbed the agricultural schools of their best opportunities in two major respects—first, by an imposed narrowness in curricular studies—thus placing essentially all students and faculty members in agriculture, engineering, and home economics in a lower status, educationally, socially, and academically.

This was in many cases a tragedy. Often it separated these new schools from the strongest divisions of basic sciences (chemistry, physics, and mathematics), sociology, music, medicine, education, economics, history, art, and many other areas essential for normal cultural and intellectual development. The unintentional stigma required several decades for correction, and was especially damaging to the strength of graduate studies.

A further handicap, arising all too often from this situation, was the antagonism and destructive competition that followed, as each institution struggled for financial support in the State legislature.

Despite these two severe handicaps, however, the land-grant schools advanced in stature and proved their right to greater recognition economically, technically, and culturally.

Within the past two decades nearly all of the land-grant colleges have become full-fledged universities, both in fact and in name. This, in my opinion, has been one of the greatest and most dramatic transitions from the original land-grant system.

An administrative trend that was very unfortunate in some of the colleges and still remains a drag on their best accomplishment, was to permit too great a separation of experiment station research and personnel from the graduate schools.

This weakness is being corrected gradually, but is still sorely obvious in some schools. In making this observation, I fully recognize that many scientists in experiment station work are not highly motivated toward direct educational work, but nevertheless continue to make outstanding contributions as experimentalists—the problem is one of emphasis and judgment rather than arbitrary rules.

The regional laboratories of the Department of Agriculture have had a very useful role despite this separation from the experiment stations. However, I have always felt that they would have been even more fruitful in results and more attractive to outstanding professional personnel—particularly the younger men—if they had been located adjacent to university centers, and preferably near a land-grant institution. I believe a closer relationship with strong graduate schools would have been of great mutual advantage.

Many scientists believe there would be a great advantage, also, from placing less emphasis upon project assignments and commodity control.

Commodity Pressures

I realize, however, that agricultural practices and organizations tend to operate on a commodity basis. The recent establishment of pioneering research laboratories in the regional laboratories is a move in the right direction, I believe, in getting greater freedom for basic research, without the restrictions of commodity pressures.

At least a few among the leading research personnel are then free to plan and study in broad categories of interest, such as proteins, fats, and carbohydrates, instead of milk, cotton, pigs, and corn.

A part of the remarkable success of the Wisconsin group in combining basic research with practical applications and statewide support is illustrated, if I remember correctly, by the experience Dr. Elvehjem had with his senior faculty member, Professor Hart.

Dr. Dr. Elvehjem had discovered and demonstrated clearly that copper was an essential nutrient for the prevention of anemia in white rats, Dr. Hart at once suggested “now can you find a farm animal that has the same requirement—perhaps even a deficient animal? That would be so much more interesting to Wisconsin farmers.” Then, but not before, Dr. Elvehjem demonstrated the relationship in pigs.

Among early experiences at Washington State University, I recall the persuasive story released by President E. O. Holland, in pointing out the economic value of the research program in genetics developed by Professor Gaines in the experiment station.

The agricultural economist estimated that the improved strain of high-yield, rust-resistant wheat that Dr. Gaines developed had brought a financial return to the wheat farmers in the State of Washington equal to the total sum of all State appropriations to the college since it had been organized.

Another illustration of their work, in which I was privileged to participate in a small way, was in solving the problem of big-necked sheep, hairless pigs, and stiff-jointed calves and colts that had long handicapped the livestock industry.

As you might guess, the whole series of problems was contingent on iodine deficiency. Soon after this situation was cleared up, of course, the medical and public health agencies applied the same principle to prevention of goiter in women and children in the same areas.

I believe too great emphasis cannot be given to the contributions made by outstanding individual scientists and teachers. This view in no sense implies a lesser regard for the contributions of administrative personnel, because, without administrative selection and wholehearted support of superior faculty members, the entire institution suffers to an astounding degree.

Having become interested in biochemistry and accordingly changed from a major in geology as a result of working in a experiment station green-

house and laboratory while working my way through school at Washington State University, and having had the privilege of serving the De-

partment of Agriculture in an advisory capacity in recent years, it is a special privilege to participate in this 100th anniversary of the land-grant system.

Discussion—Continued

Paul M. Dunn

St. Regis Paper Co.

THE SCHOLARLY presentation by Dr. Elvehjem and the well-pointed discussions of Dr. Hendricks and Dr. King have given us several thought-provoking ideas. In the few minutes provided to me for comment, I shall attempt to relate my field of interest—forestry—to the subject at hand, so ably outlined for you by the other speakers.

Dr. Elvehjem, in his treatment of the subject of research, highlighted five fundamental developments or principles. I wish to direct my remarks toward two of the aforementioned points; namely, the first—"that organized research can be a major force in the advancement of society," and the third—"that the applications of research can be accelerated through well organized communications channels." The outstanding developments of the Department of Agriculture over the past 100 years, and the specific progress made in forestry, both within the Department, by other public agencies, and by private industry over the past 60-70 years, are evidence of the soundness of those assertions.

Forestry is defined as "an applied science" and since it is a plant science, from the beginning it has been properly associated with agriculture in the governmental organization and also in field practice. The progress in this field that we cite today can be directly related to the research efforts over the years and the application of the scientific findings. We should recognize, also, the associated importance of the application of sound principles of forest land management and the adoption of fundamentals of basic education, whose contributions are increasingly apparent.

Research, both basic and applied, has played a major role in the development and utilization of the forest and related resources of our Nation, and will be an even greater determining factor in the future. I will return to this point later, as I would like to make certain references to other aspects of forests and forestry.

Resource Values; Human and Physical

The major assets of this and every nation are its resource values; both human and physical. The wealth and the development of any country depend on the kind and the supply of physical or natural resources, and the ability of her people to develop, manage, and utilize them wisely. Over the past 300 years, the people of our communities, our States, and our nations have capitalized on the wealth of our land, and the productivity of the

soil and the climate, through the production of annual or periodic crops. Certainly, we should continue to do so.

The forest, distinct from its other services and benefits of water, forage, wildlife, and recreation, supplies a basic raw material—wood—that from the earliest times has furnished mankind with many necessities of existence and with comfort and conveniences. The forests will return maximum values to the people of our United States only if they are fully and profitably utilized, and at the same time are maintained in a vigorous condition for the continuous production of forest crops.

Nearly one-third of the continental United States is either in forest growth or is suited by nature mainly or solely to the growing of trees. In a broad sense, the growing of forests or woodlands appears to be the only economic use to which the bulk of this great area, amounting to more than 600 million acres, can and should be put. The fullest development of this use is of profound importance to our Nation's present and future economy. Aside from timber, the forested areas provide benefits through favorable influence on streamflow and prevention of excessive soil erosion, protection for homes, crops and livestock against wind and drought, forage for livestock and game, recreational needs, and environmental conditions upon which the wildlife of the country depends. In addition, it is agreed that there should be a reasonable area of forested and high mountain land reserved in its natural condition for scientific and recreational use. All these benefits, though not easily appraised, in the aggregate represent very important values to the public—to us as citizens.

Timber in Our Economy

Forests are vital to our economy, welfare, and defense. It is most essential that we as a people—the public, and the industrial and the political leaders—continue to realize the importance of our natural resources, and in particular, the place of timber in our economy, as a basic raw material and our major natural resource. We, in the main, see what we are taught to see, and think as we are taught to think. That is why research for facts and their application in practice, and technical education are so important in this area for better understanding and progress.

Forestry in this country came into being, as a national movement, about 70 years ago. However, the concept of timberland management and bet-

ter utilization of the natural resources, and the development of the profession, grew out of a complexity of early-day activities and from the repeated threats of a "timber famine," which stirred the interest of both individuals and groups in the future status of the forest resource.

The early American attempts toward conservation were stimulated by specific needs for timber products and various forest tracts were reserved for special cutting. However, the first two centuries brought about no real progress, as timber was accessible and plentiful, with the more important pressure to provide homes, towns, and industry for a growing country. As was learned in Europe, the practices of forest management would be accepted only after it has been shown that the timber supplies were becoming scarce. In a few scattered areas, however, care of the timber, tree planting, and protection from fire were encouraged. Penn's Woods, Arbor Day, and the Timber Culture Act are examples.

In time, public interest grew and produced the American Forestry Association in 1875, the First American Forestry Congress in 1882, legislation to create the forest reserves in 1891, and the White House Conference of Governors in 1908. Within the period mentioned, the Department of Agriculture had expanded its program with full recognition of the Forest Service and the memorable directive of Secretary Wilson to "administer the Federal forests for the greatest good for the greatest number over the long run." There have been other forestry congresses and conferences with the tenor of the subjects broadened to cover water, wildlife, grasslands, and parks. A current announcement calls for the White House Conference on Conservation for the 24th and 25th of this month.

Sustained Yield and Multiple Use Gain Ground

The philosophies of sustained yield and multiple use have been enacted into law and are found in practice on private as well as Federal forest lands. The recent Timber Resources Review credits the managed private industry lands as being in better condition than most of the Federal forest lands. The Clarke-McNary Act of 1924 set the stage for cooperative effort between Federal agencies, the States, and private industry, particularly in respect to protection of forest lands from fire; but also provided for mutual interest projects in tree planting and farm forestry extension. The results have been most encouraging.

While various and scattered projects were in evidence over the early years, we really recognize the start of our present forestry research program, meager though it was, after the formation of the Department of Agriculture. In 1876, Congress appropriated \$2,000 for the employment of "a man of approved attainments to prosecute investigations and inquiries in protection, production and

utilization of our nation's timber supply, now and in the future, both here and abroad." Franklin B. Hough was selected and reported 4 years later that "our main dependence for advancement must consist in carefully considered experimental investigations and a discriminating publication of the results that deserve notice." Later he advised on the establishment of regional experiment stations, which should be centers of influence upon the country around them.

Research Develops Rapidly

Shortly thereafter in 1886, the Division of Forestry was established in the Department, and in 1905 that agency became known as the Forest Service. In 1908, the Fort Valley Experiment Station was established with a one-man staff in Arizona, and other units followed. In 1910, the Forest Products Laboratory came into being through the cooperation of the University of Wisconsin at Madison, perhaps one of the first examples of cooperative effort with States and universities. And in 1915, the Branch of Research was created in the Forest Service. It was the passage of the McSweeney-McNary Act in 1928, however, that provided the basic charter for Federal forest research activities. It authorized a system of regional experiment stations, a nationwide forest survey, and an expanded forestry research program. The resultant influence on Federal, State, and private industry research has been widespread.

The first attempt to practice forestry in America was on private land. In 1892, Gifford Pinchot, who later became the first Chief Forester of the Forest Service, was employed to manage the 7,000-acre forest on the Biltmore Estate in North Carolina. We have come a long way since then, with acceptable forest practices in effect on millions of acres of private and public lands. The decade of 1941-51 was a most significant period in the development and acceptance of practices that affected the quality of the forests and the quantity of forest products. These included protection from fire, insects and diseases, transportation development, wildlife and water relations, and grazing control, as well as timber cutting. Legislation, both Federal and State, was a major factor supported by good cooperation between the private landowners and the public land administrators. The Tree Farm movement, the Keep Green programs, and public education projects sponsored by the forest products industries were also prominent features. Forest research was a most important adjunct to this progress and received considerable impetus from same.

Now to return to the basic point of this panel discussion.

Forestry research, in a broad sense, doubtless dates back to the early colonial days. However, Andre Michaux, the French botanist who came to America in 1785 to investigate the suitability and

availability of North American oaks for ship timbers, initiated the first substantial study by a trained scientist. Subsequent work by his son, Francois, provided us with much of our basic information in the field of dendrology.

While time does not permit a recitation of the multitude of investigative accomplishments during the past century by major titles even, perhaps an excerpt from a recent report of the Committee on Forestry Research of the Society of American Foresters will describe the changed picture, at least budgetwise.

Research expenditures during the fiscal year 1959-60 were: forest industries—\$62 million, federal agencies—\$17 million, and educational institutions—\$6.5 million. Ninety-six percent of the industry research was in the fields of products and utilization, and of that amount 70 percent was on pulp, paper and fiber products. Expenditures by the federal agencies were 20 percent for utilization and 30 percent for timber production, while the educational institutions spent 27 percent and 33 percent in each of those categories.

The above total of \$85 million can be compared with \$40 million for the year 1953, and also with the proposed increases in the federal research budget for the years 1962 and 1963 of 29 percent and 43 percent respectively over the previous years. However, while these figures appear large and the relative advance is great, when compared with the available funds for current federal agricultural research or all industry, the amounts are small. Only 0.34 percent of the gross national product, contributed to the timber industry alone, was spent on forestry research, as compared with 2.0 percent for all types of research and development.

Several features characterize present-day research; namely, (1) establishment of industrial research units on a company basis, (2) an increase in corporate sponsorship of cooperative research projects through educational institutions and foundations by direct grants or fellowships, and (3) mutual financing of research projects by groups of companies or associations, and/or with State or Federal agencies.

First Foresters; Trained in Europe

I would be remiss if I failed to comment on the place of forestry education in this subject of

research. As concern developed for the conservation of the forest resources and it was evident that proper management of the lands was vital, and also, that research must be a major factor in providing guidelines for the practices, it was recognized that a critical factor was the lack of trained technical personnel. There was only a handful of trained foresters available in the past century; those being men trained in Europe. Of special interest to all of us is the second Centennial that we are commemorating this year, the signing of the Morrill Act in 1862, which provided for Federal support by special land grants to one college in each State where emphasis would be placed on instruction in subjects related to agricultural and mechanical arts. In 1898, the first formalized program of instruction in forestry was initiated at Cornell University in New York, a land-grant institution. It is interesting to note that of the 28 accredited schools of forestry now in operation, 21 are at land-grant colleges or universities.

In 1887, the passage of the Hatch Act stimulated the growth of experiment stations within the land-grant system, which further enhanced the facilities for teaching and research throughout the Nation. At the present time, forestry students, as well as staff, have ready access to libraries, experimental projects, and both university and Federal researchers on nearly all campuses. Federal, State, and private moneys are being pooled to underwrite special and cooperative programs in all sections of the country and covering all aspects of the various natural resource problems. The progress in the past several decades has been remarkable.

May I say that I feel strongly that the forestry record supports the contentions of the panel speaker regarding the merits of and the continued need for research. In closing, I wish to quote from Rear Adm. Luis de Florez (retired), USNR, who said, "The founders of our country needed more than labor and courage to open virgin territory, create tools, process raw materials, harness natural resources and establish communications. They required ingenuity. This quality is a continuing requisite in the competitive world in which we live. We must never fail to foster and stimulate ingenuity in America, if we are to meet the challenges ahead."

PANEL THREE

Henry A. Wallace, former Vice President of the United States and a former Secretary of Agriculture, concluded his remarks as principal speaker on the panel theme as follows:

"When we learn how—

—to develop our human relations as we have developed our production capacity,

—to retain the best traditions of our farms in an increasingly urbanized society,

—to fire ourselves and our youth with a sense of moral responsibility of purpose,

"Then we will invent even newer techniques and build the new institutions needed in a hungry world threatened with self destruction."

THE EVOLUTION OF U.S. AGRICULTURE AS RELATED TO CHANGES IN ECONOMIC AND INSTITUTIONAL PATTERNS

Introductory Statement

Edwin G. Nourse, Moderator, *Former Vice President, the Brookings Institution*

ON THE 100th birthday of the U.S. Department of Agriculture which we are celebrating this year, it should be profitable for us to glance back at a few centuries of agricultural evolution that just preceded 1862, and also venture a speculative look ahead at the century that will follow 1962. The historian's map of the road our agricultural economy has traveled should give some helpful guidance to policymakers for the future.

The life of the U.S. Department of Agriculture has spanned the second century of the interrelated institutional development commonly referred to as "the Industrial Revolution." But the coming of the Industrial Revolution—roughly dated at 1760—had been preceded by some five centuries of an Agricultural Revolution, in which the feudal peasant was becoming a free-enterprise farmer. This evolution was marked by the erosion of manorial status and rigid village custom, and by the passing of strip farming and poorly utilized "common" lands. It saw the advent of "enclosure," crop rotation, better livestock husbandry, and the burgeoning of capitalist incentive to productive efficiency in family farming.

From 1760 to 1860 in America, the explosive power of this economic emancipation of individual agricultural enterprise did much to carry us forward from infant colonialism to adolescent nationalism. Land hunger speeded the institutional development of the Homestead and Reclamation Acts, public aid to transportation facilities, and, in time, a distinctive and adequate rural credit system. Perhaps the most vital fructifying factor in this thriving system of individual free enterprise was our ingenious and comprehensive structure of popular education—agricultural colleges, experiment stations, extension service, community high schools, and competitive junior achievement clubs.

Now, as I look back over the past century of evolution of American agriculture amid changes in the general economy and the changes we have introduced into our institutional pattern, I am struck by two features of the picture. First, what we call agriculture today is not at all the same thing as the farming business of the late 19th century and early 20th. Many erstwhile activities

of the family farm have gone to town or been superseded by industrially produced products. At the same time, the source of capital and business leadership for the supply of food and fiber is increasingly to be traced to urban centers, rather than merely rural vision, daring, or opportunism. But a second process of economic transfusion has been no less significant. By building up large cooperative enterprises and developing the overhead service functions of general farm organizations and of government, farmers have, in turn, penetrated into realms of industrial processing, commercial distribution, supply of farm-used materials, and several branches of finance, all formerly preempted by urban agencies.

From Triumphant Individualism to Highly Organized Groupism

During the last 40 years of this century of the U.S. Department of Agriculture—since the post-World War I collapse of agriculture—the American farmer has been in a violent transition from a past of triumphant individualism into the troubled adolescence of an unfolding life of highly organized groupism. Agriculture cannot long remain a sort of third estate within the economy. It must accept and participate actively in the shaping of an integrated national economy—in its international setting and responsibilities.

The ineluctable forces of technology and business genius are making the farmer—in the best sense of the term—an organization man, whether his individual lot is cast as a member of the admin-

istrative elite or one of the no less important rank and file, whose level of economic sophistication, democratic discipline, and referendum power will be the ultimate determinant of the course of our future agricultural evolution.

This means that our agricultural group is committed to living dangerously. They need to see that, in seeking to be an active force, not a passive pawn, in the world of general business, the farmer shall not overreach himself and lose either his pocket-book or his soul. Similarly, he must guard against seizing short-run profit or security by yielding to the advances of nonfarm corporate enterprise, only to find himself, in time, shorn of his own freedom of enterprise. Finally, he must be alert to see that the role of government shall continue to be limited to legislation and administrative service that assures equality of opportunity and flexibility of choice and adaptation, and does not slip into hampering rigidities and government control.

The future evolution of American agriculture should be shaped toward optimum use of our national resources, natural and human, not toward the attainment of maximum market or political power. I believe that in the century on which we are now embarked, the public interest will more and more outrank class interest as the touchstone of both private and government policy. President Kennedy, early in his administration, made a ringing declaration of that ideal. His farm policy should implement that purpose, no less than his industrial management policy and his labor policy.

The Evolution of U.S. Agriculture as Related to Changes in Economic and Institutional Patterns

Henry A. Wallace

*Former Vice President of the United States
and Former Secretary of Agriculture*

DURING THE PAST 100 years the United States, Canada, Western Europe, and Australia have learned to put together capital and agricultural education in a new and very powerful way. The momentum at first was exceedingly slow. Over vast areas, 70 percent of the people still lived on the land. Thomas Jefferson hoped we would always remain a farm people. He utterly distrusted the life of people in town as I did in my youth. Liberty Hyde Bailey, the famous dean of agriculture at Cornell, phrased my feelings, my father's feelings, and my grandfather's feelings almost exactly when he said in 1908, "Upon the development of this distinctively rural civilization rests ultimately our ability, by methods of farming requiring the highest intelligence, to feed and clothe the hungry nations; to supply the city and metropolis with fresh blood, clean bodies, and clear brains that can endure the strain of modern urban life;

and to preserve a race of men in the open country that, in the future as in the past, will be the stay and strength of the nation in time of war, and its guiding and controlling spirit in time of peace."

Scarcely anyone except perhaps Henry Adams had more than a glimmer of the extraordinary changes which after 1908 would so speedily reduce the importance of the farmer as the spiritual and genetic fountain of our national being. Surely those who fathered the land-grant-college system and the U.S. Department of Agriculture 100 years ago did not anticipate how greatly they would increase the efficiency of the average farmer.

The 19th century had seen land-hungry men from the eastern seaboard move west to exploit ruthlessly the fertility of the virgin land. These men had small concern for soil erosion and saw no need for commercial fertilizer. Their great concern was with highways, waterways, and railways

so as to convert their surplus into cash in order to pay off their debts. They wanted cheap money at the risk of inflation. First, they urged the construction of railroads, and second, they fought for lower freight rates. Debt-ridden, land-poor farmers distant from market created the Grange, the Farmers' Alliance, the Green Back movement, the Populist movement, and to some extent the Free Silver movement. By modern standards these 19th-century farmers were dismally inefficient, producing less than half as much per acre and one-sixth as much per man as the present-day farmer. Nevertheless, their productive power was so great as to be largely responsible for the rapid growth of great cities in Western Europe and eastern United States. The farm and city expansions went hand in hand. Big steel, big oil, big railroads, and big electricity tied the complex system together until the automobile and the airplane could enter the picture.

The birth of big labor became inevitable, whereupon the farmer tried to get his bargaining equivalent either through big Cooperatives or through Government. During the 1930's huge unemployment and low prices for those raw materials moving in world trade seemed an ever-present peril in all the western industrial world.

Population experts predicted the U.S. population would level off at 150 million. The dynamism which had characterized the West for the century prior to 1929 seemed to have disappeared. At no time during the thirties did corporate income, farm income, or total payrolls reach the point they had attained in 1929. The horrible black magic of war released us from that stagnation. From the moment war ended, organized labor was in an increasingly powerful position. Industry retorted with automation. Organized labor then came out with many different plans for featherbedding. Agriculture's automatic and unorganized answer was to increase the size of farms, pour on the fertilizer, buy bigger machines, and cut down the labor force from 7½ million to 5 million. Coal mining did about the same as agriculture. The farmers and the coal miners increased their efficiency per man at about twice as high a rate as workers generally.

Productive Power, a Unique Blessing

There is no need to dwell on the tremendous agricultural surplus accumulated during the past 8 years. Nor is any good purpose served by trying to assess blame. My purpose is to dwell on the unique blessing which the huge productive power of the American farmer and American soil confer on the United States and the entire world.

First, I wish to analyze briefly just how the American farmer attained such expertness. On the surface it seems that it was only since 1940 that agricultural productivity burst forth in a really big way. War prices increased output by about 20 percent, but after 1950 the availability

of vast quantities of fertilizer, pesticides, big machines, and genetically better plants and animals added another 30 percent. Unless there is bad weather, atomic war, or an economic breakdown of major proportions, we may expect the agricultural expansion in the sixties to continue at much the same rate as in the fifties. The chances are that the surplus is not a temporary problem.

If we examine the record we find that modern agriculture has become a highly capitalized industry. Today the average farmer invests about 40 percent more per worker in his business than the average city industry. Today, both per farm and per worker, the farmer puts nearly six times as many dollars into his business as he did in 1940. The cost of farm labor has gone up so high that the farmer has more and more tried to put his dollars into fertilizer, machinery, and additional acres which the improved machinery has been able to care for. No wonder farmers owe \$25 billion today instead of \$10 billion 20 years ago. In the old days farmers tried to manufacture their own fertilizer with clover and manure, and to grow feed for their horses instead of buying gas for their tractors. Pesticides were little used and labor was largely home produced or cheaply hired.

Farm wage rates today are about 50 percent higher than in 1950, but the net income of the average farmer for his own labor is still less than \$1 an hour. He is able to get this high return only by cutting his total number of hours of man labor to one-half what it was in the thirties and early forties. Machinery, fertilizer, pesticides, land, and debts have been substituted for 10 billion hours annually of farm labor. In 10 years the average farm in the United States increased from 216 acres to 302 acres. In 1961, the sudden expansion of the use of weedkillers in corn brought about increased yields with less labor spent on cultivation. What it all adds up to is that the sudden expansion in productive power of the U.S. farmer in the past 20 years has been brought to pass only by the average farmer becoming a rather sizable businessman subject to inflexible costs, receiving a return of less than 5 percent on his investment, and less than \$1 an hour for his own labor. Of the 4 million farms in the United States, about 1 million do rather well. But even the 1 million best farms, on account of their fixed costs, would find themselves up against it if there were a sudden shift in the market caused by a sudden release of accumulated agricultural surplus.

Surplus Benefits the Consumer

However embarrassing the surplus is to the farmer and to Government, the American consumer has benefited and will benefit. An hour of factory labor has never been able to buy so much food so well packaged and in such variety. The contrast with the Communist countries is more extraordinary on this front than on any other. Russia may graduate more engineers than the United

States. She may produce more machine tools and for a few years hoist larger rockets into space. But there is no evidence that in our lifetime her farmers will approach ours in efficiency.

Our farmers, man for man, are about five times as efficient as the Russian farmers. This is partly because of a better climate, but largely because our farmers have had an optimum combination of free incentive, adequate capital, and a long period of sound technological training, based partly on the unique contributions of the land-grant-colleges and the U.S. Department of Agriculture, and partly on farm papers, and partly on a long series of unique inventions by private individuals and corporations. Of my own personal experience I know how much I owed in the first place to Iowa State College. But I also know that as a farm paper editor by pouring out tons of printer's ink on the subject in the early twenties, I greatly hastened the adoption of hybrid corn. Chemical pesticides and improved farm machinery were largely brought into use as a result of research financed by great corporations. After reading over an exceedingly long talk by First Secretary Khrushchev to the Central Committee Plenum on March 5 of this year, I realize that in considerable measure he is like some of our early extension men 60 years ago before the State experiment stations had furnished a firm basis of scientific fact adapted to each area. How can a scientific system of farm management adapted to each area be built up in Russia except by adopting the principles worked out by Taylor, Warren, and Spillman so many years ago in the United States? Mr. K. undoubtedly knows more about agriculture than most dictators. He is smart enough to know that agriculture is the weakest link in the Communist chain.

But somehow, earnest as Mr. Khrushchev is on the agricultural front, he finds it impossible to learn as well as impart. He seems determined to put a high percentage of the dry land areas into highly fertilized crops. He should see the film we put out in the early thirties entitled "The Plow That Broke the Plains." His March 5 speech will head the so-called virgin land area toward duststorms whenever the weather turns drier than usual.

After reading Mr. Khrushchev's speech I could see how easily the type of reasoning inculcated by dialectical materialism arrives at what seem to be logical answers but which the practical farmer knows are wide of the mark. Heavyhanded exhortation even when enlivened by proverbs and joke cracking will not suffice to bring maximum productivity.

In 1900 the U.S. farmer did not have tractors and combines as the Russian collective farms have today, but in other respects Russian agriculture today is very much like U.S. agriculture in 1900. The experimental results at the Russian experiment stations have not yet been rationalized in terms of efficient farm management area by area.

Party members stationed on a collective farm whooping it up for increased output in terms of acreages suggested by Mr. Khrushchev are not likely to have as good an effect as county agents have in the United States.

Our great food surplus properly stored is a blessing, first, because it will enable a saving remnant to survive even under the fiercest atom bomb war. Edward Teller made this point before a Senate committee shortly after the first sputnik. The military have stored away in the form of strategic metals and out-of-date equipment many times as many dollars' worth as there is of agricultural surplus. I maintain that for purposes of either war or peace our agricultural surplus has greater significance than much of the military equipment which becomes so quickly outmoded. Personally I do not believe the atomic bombs will ever fall. I may say, however, that when I proposed the ever-normal granary in the 1930's I definitely had in mind the possibility that we would eventually require much larger carryovers than the commercial interests had formerly built up. So I say that just as a stockpile of atom bombs is today looked on as a *sine qua non* of national security, so likewise large stockpiles of farm products properly placed in the United States and among our Allies is also for the time being essential.

Far more important in my mind is the way in which our export surplus is used to lead constructively the March of the Common Man. In 1942 when I first spoke of the Century of the Common Man, I did not anticipate that public health measures immediately after World War II would double the rate of population growth in nearly all the crowded, tropical parts of the world in almost the twinkling of an eye. By 1949 it became apparent that the March of the Common Man destructively led would in all probability cause more damage than the atomic bomb. My criticism of both Communists and extreme reactionaries is that both preach hate and violence.

Russia in the long run is doing herself a tremendous disservice by preaching hate, greed, envy, discord, and violence to the hungry parts of the world. By so doing Russia is playing into China's hands. Next after the United States, Russia is the greatest "have" nation in the world. If Mr. Khrushchev's dreams come true, she will be the No. 1 "have" nation within 10 to 20 years. China knows what Russia took from her 100 years ago. Across the longest border in the world she looks north to thinly populated lands as her population increases each year four times as fast as the Russian population. The Chinese have an even greater sense of racial superiority than the Germans under Hitler. The present faint rumblings of Chinese-Russian discord may continue for several decades before the underlying geographic, demographic, historic, and racial forces provoke the ultimate break. In the meantime China is

endeavoring to outrace Russia in leading the common man destructively in all the tropical areas of the world. Many of the peoples of Asia, Africa, and even Latin America respond more instinctively to Chinese propaganda than to Russian. The Chinese are a "have-not" people and they know how other "have-not" people feel. To many Asiatic and African peoples, the Russians are an imperialistic "have" nation with white skins.

Russia Made a Serious Mistake

Thus far Russia has supported the United Nations only grudgingly. She has a poor record for pulling her fair share of the U.N. load. Sooner or later as a result of the Chinese pressure I believe Russia will change her attitude and will act as a "have nation" should in a hungry world. Russia made a most serious mistake when she entered into a pact with Hitler. That would have cost her her national existence if it had not been for the United States. Russia will make an even greater mistake by remaining too long hooked up with Communist China. She should forget about the Communist-capitalist ideological fight and join the Western World in its effort to lead the common man constructively into the modern scheme of life. This is the biggest problem of this century. However, it is not realistic to expect Russia to abandon her policies of hate, violence, and deceit at any time in the next 5 or 10 years. This means that the United States, West Europe, Canada, and Japan must carry the load of helping the tropical hungry lands where the population explosion is greatest and the ratio of good land to people is lowest. These people are increasing at a rate which will double in 25 to 30 years. Most of them do not know how to read or write. To save themselves from utter misery, they must learn in 15 years the techniques which took us 30 to 40 years to learn. During the last half of the 19th century, the United States went slowly in increasing her yields per acre. During the last 40 years of the 20th century, the tropical lands must move to double their yields per acre by 1985. Capital and education can and must be provided. Otherwise the Communist system will be used to manufacture capital out of the hides of the people.

As we consider the urgency of the case, we must remember that in another 15 years the people of the tropical undeveloped and crowded areas will outnumber the industrialized West by 3 to 1. The Communist bloc will outnumber us 2 to 1. The West, including Japan, will have only one-sixth of the world's population, but it will produce more than half the industrial goods. The West does not begin to have the surplus needed to feed the hungry people, but it does have the knowledge and the capital to help get them rocked off dead center. Leading these people constructively can give the West full employment and prosperity for 30 years. I do not claim there is such

a thing as gratitude among nations. But there is such a thing as tradition, custom, and habit in trade currents.

Problem, Just How To Do It

Expansion of total world trade benefits everyone. Doubling the production of the crowded parts of the world in the next 25 years could start on its way an era almost as important as opening up the Corn Belt a century ago. The objective is clear and desirable to most thoughtful people. The problem is just how to do it. An excellent illustration of a job well done which I have watched for 20 years is the work of the Rockefeller Foundation in Mexico, directed toward increasing the yield of corn, wheat, beans, and other crops. The Rockefeller Foundation in its work at Chapingo has always cooperated closely with the Mexican Government, but has always maintained continuity of experimentation. This has paid off in a big way; food production has expanded faster than population, which is saying quite a bit because population has nearly doubled in 25 years. While Dr. J. G. Harrar started his work 20 years ago with 1 helper and the foundation today has perhaps 20 staff members, the truly significant thing is the way in which a small amount of yeast has leavened the whole loaf. Of the 500 Mexican boys who have studied at Chapingo, nearly 100 have taken postgraduate work in the United States. New sorts of corn, wheat, and beans, and new sorts of fertilizers have greatly raised yields per acre. The population explosion in Mexico has been accompanied by an agricultural explosion.

Nevertheless, in spite of all the splendid work by the Rockefeller Foundation, the per capita income of Mexico is still only one-seventh that of the United States and 40 percent of the people cannot read and write. There is still a great shortage of the capital and education needed to bring Mexican productivity up until it is one-third that of the United States. When I was graduating at Iowa State at Ames more than half a century ago, the Mexican revolutionaries of that day cried out:

"Viva Madero
Poco trabajo
Mucho dinero."

This spirit has represented the soul of many revolutions. Hatred of foreigners and confiscation of foreign property scare off foreign investment. Down the path of resulting economic degeneration comes a time when either the Chinese, Russian, or Russian-trained native Communists can step in first with promises of land reform and immediately after with ironclad dictatorship set up for the purpose of creating capital by imposing long hours, hard work, and the minimum of consumer goods.

The constructive reply to the violent dictatorship sponsored by Communists is education.

Over 50,000 foreign students study in U.S. universities. While most of these students come from the so-called undeveloped countries, only about 13 percent of them are studying the social sciences and the art of public administration. My guess is that foreign-born trainees in government will find U.S. training baffling until they understand our history and then try to translate our approach so it makes sense against the background of their history. The students who come from rural undeveloped lands to study in the United States should study our rapid, helter-skelter, rather hit-and-miss efforts as we have changed so suddenly from a farm people to a city people. They will surely wish to hold on to some of their ancient values as they strive to establish electrification and roads, and to locate factories so they can build a civilization which is neither urban nor rural, but one designed to serve all people in abundance against a background of earth and trees with continuous and full awareness of the growth processes and the seasons.

Not Bread Alone

Every civilization which is 50 to 80 percent rural and which is inefficient in using labor to produce human satisfactions must remember certain things as it aspires for a higher standard of living. First, the matrix in which humanity has been formed over the millennia is the land and that which finds full expression in the open country. Second, growing crops and raising animals means continual awareness of growth processes and daily work not only by the father and mother but by the children as well. Third, the higher standard of living which industrialization inevitably brings can cause psychic, esthetic, and spiritual losses as well as material gains. Fourth, the great advantages which urbanization brings to the few can be spread to the many in ways which do not harm those who live on the land.

Less highly industrialized countries can learn from our mistakes as well as from our success. I would feel optimistic if we did not have to work so fast. The Philippines and Puerto Rico are excellent testimonies to the power of education in troubled areas of the world. What we started in these two countries early in this century has resulted in workable democracy. What our schoolteachers started is bearing some fruit.

I note that nine universities in the United States, only one of which is agricultural, are setting up a technical institute in India with funds from AID. This is fine, but I submit that so many Americans are so far away from the farms that this new educational corporation may not serve India so effectively in the next 20 years as the Rockefeller Institute has served Mexico in the past 20.

The very essence of what the United States stands for is that it is possible by democratic methods to bring about reform before revolutions

are necessary. Revolutions almost inevitably bring about dictatorship, hatred, suspicion, violence, and sooner or later economic downgrading because of capital destruction. In a true democracy with adequate education, reforms may be bitterly denounced, but if the onrushing future demands reforms, they will eventually be made into law in the United States by nonviolent methods.

In 1933 in northwest Iowa we experienced among dispossessed farmers a certain amount of violence on the part of the Farmers' Holiday movement. Early in our history we had Shay's Rebellion and the Whisky Rebellion. On the whole, however, 99 percent of our farmers have striven for reform rather than revolution. In the main I would say this is also true of labor in spite of considerable violence by small segments of labor on behalf of featherbedding. While Thomas Jefferson is said to have spoken for the need of revolution in every generation, this has not been the path of the United States. While certain Latin American countries, afflicted with overconservative landlords, greedy money lords, and grafters feeding at the public trough, may have revolutions every 2 or 3 years, the United States will continue to oppose revolution with sensible reform adopted in time. By using democracy based on timely reform we can put our terrifically efficient agriculture at work producing those surpluses which will help those nations still in the dark to catch a glimpse of a future based on constructive hope, not hate.

Agriculture politically, economically, and institutionally has weakened itself by overproduction. Individually there are a million farmers in the United States who, while they may do a lot of work with their hands, nevertheless are a very high order of businessmen, trained in science, economics, farm management, and financial awareness. These exceptionally capable men and their families represent only 3 percent of our population, but they furnish nearly all of our food. They are individuals and have never been institutionalized by any farm group. They learn from the farm papers, the salesmen of farm products, the agricultural experiment stations, and the U.S. Department of Agriculture. It is because of these men that we are so far ahead of the Communist world in food production.

The 2 or 3 million farm families which must get jobs in town in order to get by are handicapped by inadequate capital, small farms, or lack of up-to-date agricultural training. They produce a considerable part of the children who swell the unemployment rolls in the cities. If reform is to continue to outrun revolution in the United States, we must make adequate job training available for young people displaced from our farms. These children must be retrained for useful work in our society at a time when automation is cutting down on city jobs and when greater skills are required in

our increasingly complex urban civilization. Our rural youth must not become alienated from the rhythm of nature and from the feeling of belonging to a purposeful society. We must provide them with training and a sense of challenge. We must produce the moral equivalent of the discipline of physical labor and the spiritual value of working with living things which our grandparents gained from life on the farm.

We cannot do less for our city children. Traditionally, our city children who could not follow the road to adulthood through schools and colleges could find jobs on the farms or in small stores or factories. This road to adulthood has largely been cut off by our increased industrialization, with its giant business, giant labor organizations, and automation. Our inventiveness and our idealism enabled us to conquer a continent, to organize an International Red Cross, to plant the seed for a United Nations. We have risen to many crises.

Wasted Youth, a Challenge

We must not allow the ingenuity of our farm youth to be wasted in a world which is primarily agricultural and is in need of our agricultural skills as well as our food. A hungry world is a dangerous world. Wasted youth in our own and other countries provides a challenge.

In the deep depression of the 1930's the Civilian Conservation Corps demonstrated that young Americans could build both their country and themselves in a program of national service. Aimless youth from city slums were introduced for the first time to the joys and discipline of life in the open country—reclaiming themselves at the

same time they reclaimed our watersheds and forests.

Can we do less today in a world situation far grimmer even than the desperate days of the great depression? Can we do less than we did in the 1940's when we sent our ablest youth to fight a war for freedom against one of history's bloodiest dictators? We found during World War II that not only were all of our youth needed but that the aged and infirm who had lost a sense of purpose could reclaim themselves and make valuable contributions to the war effort.

We must bring some of the moral equivalents of the responsibility of working long hours with living things—attuned with the rhythms of nature—to our urban youth. We must find a way to provide job opportunities for part-time farmers who do not want to give up agriculture as a way of life. We must provide for our youth and ourselves a sense of purpose before we can achieve social inventions that will keep pace with our alarming instruments of destruction.

When we learn how to develop our human relations as we have developed our agricultural productive capacity, when we learn how to retain the best traditions of our farms in an increasingly urbanized society, when we learn anew how to fire ourselves and our youth with a sense of moral responsibility and of purpose, then we will invent even newer techniques and build the new institutions needed in a hungry world threatened with self-destruction. Then, as Liberty Hyde Bailey might say if he were here today, we can develop a race of men that will provide the moral leadership and be "the stay and strength" of all mankind.

Discussion

Bushrod W. Allin

*Chairman, Outlook and Situation Board
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MY ATTENTION is attracted especially to one aspect of Mr. Wallace's paper—not because I disagree with what he says, but because I feel the urge to clarify it. I refer to his explanation of the phenomenal increase in the productivity of agriculture in the United States as compared with that of the Soviet Union. He finds the explanation in the activities of the top million of our commercial farmers who "are individuals and have never been institutionalized by any farm group. . . . It is because of these men," he says, "that we are so far ahead of the Communist world in food production." But why do these million "individuals" act differently from the top million in Russia? My answer is—largely because of differences in the institutions under which they make their choices. Institutions are collective action controlling, liberating, and expanding individual action. They include actions by governments, political parties,

labor unions, corporations, farm organizations and cooperatives, churches, chambers of commerce, and the thousand organized lobbies that help to "educate" our public officials.

The collective action of these organizations creates a complex system of inducements and penalties or working rules within which individuals make their choices. In a most significant paragraph, Mr. Wallace puts the same idea in different words when he says:

The very essence of what the United States stands for is that it is possible by democratic methods to bring about reform before revolutions are necessary. Revolutions almost inevitably bring about dictatorship, hatred, suspicion, violence, and sooner or later economic downgrading because of capital destruction. In a true democracy with adequate education, reforms may be bitterly denounced but if the onrushing future demands reforms they will eventually be made into law in the United States by nonviolent methods.

I take this to mean that his essential distinction between totalitarian and democratic states is that the former resolve their social conflicts by physical force or violence, while the latter do so by collective bargaining and persuasion. He alines himself on the side of democracy, and, I think, on the side of most Americans.

New Institutions Honored

As Secretary of Agriculture, Mr. Wallace was a reformer in the 1930's when he improved the choices available to both his top million commercial farmers and the low-income farmers. He did this by his administration of the Agricultural Adjustment Act, the Farm Security Act, and other New Deal farm legislation. And I helped him do it. When he walked across that stage of history, he created new institutions and gave new functions to the institutions we are now honoring in this Centennial year; namely, the Department of Agriculture and the land-grant colleges.

In honoring these institutions, this forum will refer again and again to the great role they have played in increasing our agricultural productivity, but we shall do them a disservice if we exaggerate that role. As Mr. Wallace has pointed out, much of what has happened is the great substitution of capital for human labor and animal power. Machines, fertilizer, pesticides, gasoline, and electricity have been substituted in great quantities.

What we have done since 1917, the year we entered World War I and the year when Russia had her revolution, is not only to expand research and extension work, but also to see that farmers get enough money to buy these production-increasing materials.

The Department today is deeply involved in the administration of "action" programs to support farm prices and incomes at reasonable levels. These programs are especially helpful to our commercial farmers who are engaged in the production of cash crops. A foreign visitor once suggested to me that the reason for our great agricultural productivity is the great wealth of the nonfarm sector of our economy. What he meant was we could afford to be generous with our farmers—especially since our farm population is a relatively small part of our total population. As I see it, the evolution of U.S. agriculture to its present state is both cause and effect of changes in many institutional "patterns." Development of corporate industrial and financial capitalism was a powerful force favoring the assembly of capital in quantities that encouraged technological invention and its exploitation.

The abuse of power under this system fostered both labor and farmer movements. The distribution of our enormous land resources in family-size units provided an escape hatch for the discontented. Organized farmers passed the Granger and other regulatory laws. The Hatch Act and the Smith-Lever Act completed the Department

of Agriculture land-grant-college system for promoting farm efficiency. But the really great increases in farm efficiency came later in connection with wars.

In the post-World War I recession, labor got protection from foreign competition through legislation limiting immigration. Business got the Fordney-McCumber and Smoot-Hawley Tariff Acts. Two farm machinery manufacturers (George Peek and Hugh Johnson), with the aid of Mr. Wallace and Chester Davis, led farmers who grew export crops in an unsuccessful movement designed to protect them from foreign competition through the McNary-Haugen two-price plan. They got the Federal Farm Board instead. This was followed successfully, under the leadership of Mr. Wallace and M. L. Wilson, by the New Deal with its Commodity Credit Corporation and acreage allotments, which not only put floors under farm prices and incomes but also saved the jobs of many county agents. At this point, the Department was not only teaching farmers how to increase production through better production practices; it was giving them a "double barreled" inducement for doing so.

So-Called Emergency Becomes Permanent

It was giving them price support on *all* they could grow on their acreage allotments. The result was phenomenal increases in yields. If anyone asked why this was done, the answer was that acreage allotments were more easily administered than bushel allotments, and the surplus problem was regarded as "emergency" rather than chronic. The hope lingers in many minds that when the emergency passes they can return to *laissez faire* and "free competition." But the "emergency" has never passed. Hence the current emphasis on "supply management" with effective controls.

In the Department of Agriculture we maintain a statistical series designed to measure for the Nation as a whole changes in farm output per man-hour of direct labor on farms. This index in 1961 was double the level of 1950. Such phenomenal increase is by no means the result only of changes in the efficiency of farmworkers. It is the result also of massive substitution of capital (indirect labor) for farmworkers. Since 1950 the total number of people employed on farms and the total number of man-hours worked has declined about one-third while total farm output increased 25 percent. Like the coal industry, as Mr. Wallace points out, much of the increase in agricultural productivity is due to the increased efficiency of machine manufacturers. In fact, it is due to the increased efficiency of all segments of our economy who supply the farmer with any production goods he requires in the production of farm products.

This is part of what Mr. Wallace means when he says at the very beginning of his paper that "the United States, Canada, Western Europe, and

Australia have learned to put together capital and agricultural education in a new and very powerful way." Western culture has produced institutions that provide inducements for farmers to become efficient. These institutions are what Mr. Wallace calls "reforms". They have changed Industrial and Banker Capitalism to what Dr. Nourse calls a People's Capitalism. Others give it less respectable names.

Technological advance in U.S. agriculture usually results in an increase in *total* output, as well as an increase in *rate* of output. Too much total output becomes too much supply in relation to demand, and, without the assistance of Government price-support programs, adversely affects farm prices and incomes. This happens because farmers are not organized like steelworkers and coal miners to retain for themselves a fair share of the benefits of an increased rate of output.

It is partly because of the existence of Government price-support programs that Mr. Wallace finds the top million farmers doing "rather well," and expects them to continue doing so provided there is no "sudden shift in the market caused by a sudden release of accumulated agricultural sur-

plus." He finds the surplus and the huge productive power of the American farmer a "unique blessing," provided we have the good sense to make constructive use of it in the current unsettled international situation.

Use of our surplus is constructive (1) when it is distributed to our hungry at home through such programs as the Food Stamp and School Lunch programs, and (2) when it represents a positive national purpose of helping our friends and allies abroad rather than a policy of merely "getting rid" of our surplus.

I suppose it could be argued that any surplus piled up under price-support programs in excess of the amounts that can be used constructively is just as truly "featherbedding" as in the practice on the part of a very small fraction of organized labor who insist on staying on jobs that have already disappeared under the impact of technological advance. In any case, surplus-control programs obviously need to be accompanied by effective programs for providing alternative employment for farm people who are being squeezed off our farms, even in the face of price-support programs.

Discussion—Continued

Robert K. Buck

Farmer, Waukeee, Iowa

THE WALLACES and *Wallace's Farmer* have been important institutions in Iowa and the Midwest for a long time. My grandfather was a close follower of Uncle Henry Wallace. My father regarded Mr. Henry C. Wallace as the ultimate authority on what was good farming and good farm policy. I got my first interest and training in agricultural economics in the early 1930's reading the editorials by Henry A. Wallace in the *Wallace's Farmer*, whose motto was then and still is—"Good Farming, Right Living, Clear Thinking."

Even for one who has actually farmed during the period of scientific and technological development which Mr. Wallace analyzes, it is a breathtaking experience. I planted 20 acres of corn with a team of horses and a two-row planter in a very long day in 1930. In 1960 I planted 60 acres a day for 3 successive days with a four-row planter and applied fertilizer and insecticide in the row. In 1930 I harvested 100 bushels of corn in 1 day by hand and scooped the corn into the crib. In 1960, three of us harvested 1,800 bushels in a shorter day and took care of considerably more livestock than in 1930.

Mr. Wallace presented a clear picture of the roots of this technical revolution and its impact on the structure and operation of the American farm. I would like to elaborate briefly on several points which he developed.

There is widespread agreement that the great increase in farm productivity is a result of new methods, improved know-how, additional capital, as well as farm reorganization and enlargement. But it also rests on the remarkable development alongside the farm of manufacturing, service, transportation and processing industries. Many of the workers who left the farm are still contributing substantially to farm production. They manufacture, sell, and service the tractors, machinery, tools, livestock equipment, fuel, fertilizer, feed, seed, insecticides, and building materials used on the farm. They live in Detroit and Chicago and Des Moines, but many of them live in the service centers in rural areas working in the elevators, feed and fertilizer stores, hardware stores, garages, implement dealers, etc. They are mechanics, welders, electricians, plumbers, truck-drivers, carpenters, chemists, plant breeders, etc.

Just 20 years ago over 70 percent of the inputs on farms were farm labor and real estate, but now these farm-produced inputs comprise only 44 percent while nonfarm, purchased inputs are 56 percent of the total. Many of these cash farm costs reflect administered prices and have risen rather steadily in recent years. This ever-expanding, high overhead of annual purchased inputs is one of the sources of economic vulnerability of commercial farms.

Mr. Wallace says that "agriculture politically, economically, and institutionally has weakened it-

self by overefficiency." This might be called the dilemma of American abundance.

This overrapid introduction of new technology and capital into agriculture is the root of our major farm problem. It has caused production to expand faster than demand—a demand that is relatively inelastic for most farm products.

In the last decade, economists have made an important breakthrough in understanding and measuring the market demand for farm products individually and in total. Their research helps explain why the excess production resulting from the "overefficiency" about which Mr. Wallace speaks has such serious economic consequences for farmers.

The domestic demand for food grows principally in proportion to the rate of our population growth and little in relation to increasing per capita incomes. A small percentage increase in supply in a free market has a rather drastic downward influence on most farm prices.

Except for periods of war or unusual drought, farm production has pressed on demand most of the time in the last 40 years, and especially so in the last 10 years. As a result, returns to farm labor and capital have fallen behind returns to similar resources in the nonfarm economy.

It is generally agreed that this galloping productivity would be economically disastrous for farmers without Government programs of storage, price support, domestic and foreign aid, as well as production adjustment and land retirement.

A Matter of Economic Justice

Some people ask, Why should the Government be so heavily involved in agricultural adjustment, price supports, storage, etc.? How do you justify such a large farm budget? To a considerable extent, it must be justified as a matter of economic justice. Farmers do enjoy praise for their increased productivity, but they are becoming frustrated and feel a sense of injustice in being penalized economically for their increased efficiency.

Excess capacity in agriculture that constantly threatens farm prices and incomes is, in a large sense, "built in" by a long period of Government policies and programs promoting efficiency and expansion.

No other national government has invested so lavishly to increase food production as ours. No one has questioned this longtime policy of agricultural expansion. Over a long period of years, we have been, and we still are, investing billions of dollars of public funds in research and educational programs to develop and disseminate new technology; in land development, electrification, and irrigation programs; in investments in fertilizer, lime tiling, drainage, terracing, etc.

All of this enormous public effort over the years is accepted in the name of *progress* and *efficiency*. The only point I would make is that we ought to

be mature enough to pay the price of our success, and not panic at dealing with the problems of excess capacity and surplus production. As a matter of simple justice, the farmer ought to retain part of the benefits of his increased productivity.

As policy goals, I doubt if we can have lower food prices, lower Government costs for farm adjustment programs, and higher farm income all at once.

It is often observed that the Communists achieve economic growth by sweating it out of their citizens in lower current standards of living. We should remind ourselves once in a while that, in our own amazing growth, part of the progress came "out of the hides" of some of our people. I'm speaking of the families in rural areas who are bypassed or squeezed out by the technological revolution in agriculture. One only has to visit these people in their crowded urban neighborhoods or their drab rural homes to observe that they are bearing heavy costs of economic growth. Mr. Wallace argues that we can do better, and I agree.

Most authorities agree with Mr. Wallace that production will continue to press on markets for the foreseeable future. As a matter of perspective, however, I believe it is a mistake to regard the trends in production during the 1950's as indicative of the 1960's. Yields in the early 1950's reflected several poor weather years in large sections of the country, while the 4 years 1958-61 reflect a highly favorable weather cycle.¹ This gives a sharp upward trend in yields in the 1950's. We may make major errors in farm policy if we assume that this sharply upward trend of the 1950's is mostly a result of exploding technology and will continue at the same rate in the 1960's.

Production-Oriented Institutions

As Mr. Wallace indicated, one of the principal engines driving this expanding agricultural productivity is the research and educational resources of the USDA and the land-grant colleges. In their first 100 years both the USDA and the land-grant colleges were, to a large extent, production oriented. Even after the problems of excess production became critical in the last 30 years, governmental investments have been constantly expanded in large programs for reclamation and resource development as well as programs to develop and disseminate new technology.

No one is talking about stopping progress or turning the clock back, but I do think we need to take a hard look at the role these two great institutions should play in the next 100 years, especially in view of the tremendous increase in resources devoted by private industries to the

¹ Dr. Louis M. Thompson, associate dean of agriculture at Iowa State University, has made a thorough evaluation of weather factors in the production of corn, wheat, soybeans, and grain sorghum for the years 1935 to 1961. Four separate reports were circulated early in 1962 by the Center for Agricultural and Economic Adjustment.

development and dissemination of new technology in agriculture.

The most critical problems on which American farmers need help in the years ahead are *economic problems*—problems of balancing supply with markets, of developing and maintaining bargaining power, of changing organization and structure of farms and markets, of business management. Some of these problems are controversial, and all are difficult—but this is where farmers are hurting.

The second challenge, and by all odds the most important, is the whole complex of agricultural problems faced by the “have not” people in the

newly emerging nations. Mr. Wallace states: “This is the biggest problem of this century.”

We have the trained manpower in agricultural research and education and development. Many of them can be spared from conventional domestic farm problems, especially in view of the rapid expansion of private resources in this area.

In my opinion the crucial test of the leadership of both the USDA and the land-grant institutions in the next decades is how adequately they deal with these domestic economic farm problems and with the agricultural problems of the emerging nations of the world.

Discussion—Continued

Howard A. Cowden

Member, Board of Directors

Consumers Cooperative Association

MR. WALLACE spoke of cooperatives being the bargaining tools of the farmer. Because of my background and work with cooperatives, I will direct my comments to an expansion of the subject of cooperative development in the United States and the role cooperatives of the Western World can and should play in helping the emerging nations of the world.

I would be extremely remiss if I did not first pause to pay tribute to the Department of Agriculture, and especially its Farmer Cooperative Service, to the land-grant colleges, and to the many individuals within these institutions to whom the cooperatives in the United States owe so much. It was and is all these who over the years have fostered the growth of cooperatives, who provided vision and coordination and in many instances the technical guidance which in large part accounts for what success the cooperatives in this country have achieved.

Much of the impetus for the development of our farm supply and marketing cooperatives, our farm credit system and our rural electric cooperatives took place under the administration of Henry Wallace.

It is often stated that social and economic progress in this country has not kept pace with scientific and technological progress. That this is true in the field of agriculture is only too well evidenced by the fact that our abundant harvests are not always considered a blessing in a world that, the Food and Agriculture Organization tells us, sees more than half its people going to bed hungry every night.

Farmer cooperatives provide a better balance between the social and economic and scientific thinking of today's farm family. From one end of the world to the other the cooperative formula has proved, and is still proving, the most effective means of achieving economic well-being.

Cooperatives have made a great contribution toward the production of an abundance of food and fiber. They have been active in improving and standardizing quality, in using modern merchandising methods, in lowering costs, and in many other ways contributing to the most productive agriculture in the world.

Co-ops—\$2½ Billion, 1929; \$12 Billion, 1960

They have had a steady and sound growth. The 7,000 cooperatives of 1920 became 12,000 in 1929—both marketing and purchasing—and their total business grew to \$2½ billion. By 1960, even though the farm population declined substantially, memberships increased, and business volume grew to \$12 billion. Capital invested in farmer cooperatives of all kinds reached a total of \$2 billion.

Despite the progress made, cooperative development has lagged far behind other types of corporate business during periods of relative prosperity.

All around us we see a drive for further economic integration. Part of this is, no doubt, for market prestige, but I suspect that the bulk of the integration taking place in corporate businesses is to achieve greater economic efficiencies. The companies that supply and/or compete with our cooperatives are the very ones in the forefront of the integration movement.

Time does not permit a company-by-company and industry-by-industry report describing what I am trying to say, but I think at least one thing is abundantly clear. We can no longer, for example, think of expanding by building a nitrogen fertilizer plant to meet a small increase in demand for fertilizer, or a small refinery to meet increasing demands for oil products. We must think in terms of the entire integration of an industry.

When we read of Borden's moving into space research and chemical operations; when we read of

Swift's receiving 28 percent of its net earnings from insurance business operations; and when we read that the main activities of the chemical and oil companies in the sixties is to "integrate backward toward raw materials and forward toward the ultimate consumer," then, I feel, it is time we start to question some of the traditional thinking and methods of cooperative businesses. We need, urgently, more cooperation among cooperatives.

We have built our local and regional organizations in the belief that they are necessary to the survival of the independent farmer. In the main, we have done a good job, but there is nothing in the current national economic picture to suggest this is a time to rest or relax. Cooperatives cannot survive in the present world of bigness unless they match the industrial giants of our economy in efficiency and in ability to adjust to changing conditions. In some areas, certainly, the logical way to attain greater efficiency is through more cooperation among cooperatives.

We shall see in the future, I am confident, much more joint activity between cooperatives which now engage only in the farm-supply business and cooperatives which now engage only in the marketing of farm products. I would go so far as to say that this concept sooner or later should be more widely employed in the development of international markets for farm products. The big consumer cooperatives of Western Europe would seem to offer the farmer-producers of this country readymade outlets for some of the products which now move out of the United States into the hands of private producers.

Many of us in cooperatives have been giving a great deal of study to the question of how we can increase cooperation among cooperatives in all countries of the world, and how cooperatives can help strengthen democracy, especially in developing countries. Cooperatives, I believe, have a contribution to make to international understanding and peace. They are the most inexpensive form of foreign aid.

At every international cooperative meeting I am impressed by the eagerness with which the delegates from the developing countries seek help and inspiration and encouragement in their efforts to realize more fully the potentials of cooperatives

as the middle way and to get the job done before it is too late.

The premier of a new nation in Africa said: "Cooperatives through their basic structure have helped tremendously in preparing our citizens to assume the grave responsibilities that are contained in complete political freedom."

The Minister of Cooperatives in Tanganyika told a New York Times correspondent: "One third of the members of the legislative council are co-op managers or people who worked for co-ops. This is significant," he said, "because it shows the movement itself has trained people who can lead in economics and politics, and we need leaders in this country." This statement is an indication that cooperatives are already training people in democracy, and thus strengthening democracy itself, in some of the developing nations.

A Call to Service

That there is a great need for this is not a conclusion which only I have arrived at, but it is the announced position and desire of the representatives of these countries. Nor is this desire limited to any one section of the world. Throughout Latin America, the Middle East, Asia, Southeast Asia, and Africa, the demand for cooperative technicians and other types of aid from cooperatives in the developed parts of the world is heard. Our belief in stewardship, in its full economic and human meaning, calls for us to respond to the fullest extent possible.

With the passage of the new AID legislation, with the desire of our Government to help the people of these countries, there is a rare opportunity, one which will enable the cooperatives of the Western World to actively participate in the building of economic and human institutions in these countries, and an opportunity which, I believe, will help our own cooperatives mature and grow in stature.

I believe if everyone concerned will work toward expanding and strengthening cooperatives in the United States and in exporting the cooperative idea and technique to the developing countries, we will see the ushering in of a new age and a public recognition of cooperatives as an important economic and social force in the community of man.

Discussion—Continued

Margaret G. Reid

University of Chicago

KNOWLEDGE OF consumption has two different branches. The Department of Agriculture, with wisdom and breadth of view, contributes to both. The starting point of one is to view the market as seen by sellers, to interpret information about its efficiency and expansion. The starting point of the other is the consumer buyer and how wel-

fare is affected by distribution of income to families and by the functioning of the economy in general. This second branch is my specialty. My comments touch briefly on nutritional adequacy, economic development, and restriction of production. But I want mainly to comment on the incomes of farm and nonfarm families.

The first half of the 20th century saw large gains in attaining nutritional adequacy. Many conditions contributed to these. Among them are a marked rise in real income, increased agricultural production, the development of a farflung market system equipped to handle perishable foods, a great advance in scientific knowledge of what constitutes a good diet and what foods will provide it, the enrichment of cereals and an extensive program of nutrition education. Nutritional studies, dietary surveys, and annual estimates of the food supply tell the story of this progress. The *Yearbook of Agriculture 1959* summarizes the situation of the midfifties. At that time about one-tenth of the families were found to have poor diets. Historically, this implies a very high level of nutritional health. Dr. Clark, in describing the trend, states:¹

Improvement in diets in the United States over the past few decades was greatest for low-income families . . . The poorer families ate more grains and thus benefited most by enrichment programs. They also made much greater gains in the consumption of meats and citrus fruits.

In this upward trend farm families on the average have had slightly better diets than nonfarm families, in part because some of their food supply comes directly from the farm at relatively low cost.

High-income families are still more likely to have good diets than low-income families. Thus, the continued rise in real income should reduce further the percentage of the population with poor diets and should increase further the percentage with a wide margin of safety. Insufficient calcium and ascorbic acid now account for most poor diets. They could be made good by a little more nonfat milk products and fruits and vegetables. Such foods are now consumed in larger quantities by high-income than by low-income families. Consequently, their consumption seems likely to increase with further rise in real income, unless it is checked by increase in price.

Dietary surveys, however, give no reason to suppose that a further increase in real income will eliminate all poor diets. Thus, nutrition education continues to be important. Calcium and ascorbic acid need to come up and calories need to come down. Obesity is a serious dietary deficiency. In some respects, our economy of abundance should be indulged in with restraint.

Economic development is my second topic. It is almost synonymous with increases in per capita real income. In level of real income the United States leads the world. Many conditions undoubtedly contribute to this eminence; the rapid introduction of technological change, utilizing new scientific knowledge is certainly one. A relatively free market giving play to the initiative and enterprise of a large part of the population is

another. Increased productivity is fairly general and certainly very marked in agriculture and in manufacturing. Now automation is revolutionizing clerical as well as some other jobs.

Increase in productivity has been variously interpreted. One interpretation is that products will be in such abundance that they will find no buyers, but will pile up in warehouses. To me, such surpluses are merely a symptom of a barrier in the market economy that interferes with products moving to consumers at prices that will clear the stock, and thus making way for a further flow explicitly related to current consumer demand. All historical evidence implies that increased productivity in each and every part of the economy is a good thing. If there is a saturation point to total consumption, that point is not yet in sight. As real income rises, consumers have shown a desire to have more leisure, but they have clearly demonstrated a desire for more consumer goods.

Agriculture's place in an expanding economy is of special interest to this audience. The evidence appears quite definitive. It is to be seen in our economic history as well as in the importance of agriculture throughout the world in countries at various stages of economic development. With rise in real income a smaller percentage of total resources tend to be in agriculture. Such a decline has by some been ascribed to an exceptionally great increase in the productivity of agriculture. If this has occurred it has intensified the trend. However, even where the rate of increase in productivity is the same in all sectors an important decline in agriculture's share of national income seems probable. It reflects change in consumer demand with rise in real income. In the allocation of increased income the share going to food tends to be relatively small compared to the share going to other products. Hence, continued economic development will create the need for further shift of resources out of agriculture into other uses, and any condition that facilitates this will, in turn, contribute to economic development.

Bigger and Better Restrictions?

My third topic is restriction of production. The United States historically has been in the vanguard of countries seeking to use competition as a means of promoting increases in national income and the sharing of its benefits. In general, those who presume to represent the interest of consumers feel that competition, within a framework of market rules, is the best means of achieving a maximum volume of goods at fair prices and a market responsive to change in demand. Imperfections have always existed. One of the questions to be considered is whether we shall strive to reduce any restriction on production favoring one group while it limits the income or the purchasing power of the dollars of another group, or whether the existence of one restriction is going to be countered by imposing another. In other words, should

¹Corinne Le Bovit and Faith Clark, "Are We Well Fed?" *Yearbook of Agriculture, 1959*, p. 622.

the course of the future be set to foment a battle for bigger and better restrictions? In this matter, agriculture is deeply involved. The question here raised has been the subject of extensive debate, and I am not going to dwell on it beyond noting that it involves one of the major issues, if not the major issue, confronting the economy. There is urgent need for the development of feasible procedures for getting back into the market economy that portion of agriculture now relying heavily on restriction of production, price supports, and Federal subsidies. There is also urgent need to develop procedures for reducing other restrictions on nonagricultural production.

As I read the signs of the times, the state of public opinion against restriction and in favor of competition is increasing in intensity. We are gradually freeing ourselves from psychoses engendered by the great depression, and are coming to realize that its repetition is a very remote threat. Currently, there is evidence that we are lagging behind some countries in our rate of economic growth. Hence, a concern exists, not that we will be surfeited with abundance, but that our future achievement, our affluence, may appear meager compared to that of some other countries. Furthermore, an international frontier is being opened and many programs of real merit are greatly handicapped by restrictive practices originally conceived only in terms of internal relationships of a stagnant economy. Thus, several conditions are strengthening the plea of consumers for less restriction on production and more reliance on competition.

Money Economy or Subsistence Economy

From this broad review of nutrition and of the consumer interest in the functioning of the market economy, I want now to turn to comment on family income. On this matter there is a large and ever-growing body of information. Even so, estimating relative real income—for example, that of nonfarm and farm families, in terms of purchasing power—the income crucial to welfare, is no simple matter. The one group is almost wholly in a money economy and the other is still in considerable measure in a subsistence economy. Much of the information available describes only money income, and this tends to understate real income, and the understatement is greater for farm than nonfarm families.

Secretary Freeman recently reported to Congress that mean cash income of farm-operator families for 1959 from all sources was \$4,410, and that total income including nonmoney income from farm food and housing was \$5,553.² This estimate of total income exceeds the money income by 26 percent.

Two additional adjustments would probably improve it as a basis for comparing average in-

come of farm-operator families with that of any set of nonfarm families. One relates to consumer prices. In estimating nonmoney income, food is valued in terms of sale prices. Because of this and other price differences the purchasing power of dollars of farm income is somewhat higher than that of the rest of the economy. One estimate of this difference is available. It shows that prices of city families tend to be 18 percent higher than those of farm families.³ If this estimate is now applicable, then a total income of \$5,553 of farm families would be comparable to a city income of \$6,553.

Farm families also have an advantage on income tax. Higher purchasing power of dollars keeps them in a relatively low tax bracket. In addition, one-quarter of their total income is probably not subject to tax. In terms of the estimates just described, the farm-operator families have an income tax advantage of about \$200.⁴

Several years ago an examination of incomes of 1949 led me⁵ to conclude that—

When income tax, purchasing power of dollars, and persons per consumer units are taken into account, nonfarm people had \$115 for every \$100 of farm people. . . . When incomes . . . are standardized by States, the disposable equivalent purchasing power in 1949 appears to have been much the same for farm as for nonfarm people.

These estimates of farm-family income create a sense of optimism in those concerned with the raising of the income of people on farms.

Certain information becoming available during the fifties implied that the rise in the income of farm families was lagging appreciably behind that of nonfarm families, in spite of the expansion of off-farm work and the decline in the population on farms. Yet between 1949 and 1959 the average money income of farm-operator families increased 82 percent, that of farm labor families by 52 percent, that of all farm families by 73, and that of families of all nonfarm occupational groups by 71 percent.⁶ In other words, the percentage increase in average money income was very slightly greater for the families of farm than nonfarm occupations,⁷ and the gain was appreciably greater for families of farm operators than of farm laborers.

³ Nathan Koffsky, "Farm and Urban Purchasing Power," Conference on Research in Income and Wealth, *Studies in Income and Wealth*, National Bureau of Economic Research, vol. XI, 1949, pp. 156-178.

⁴ This estimate is derived from *Study of Consumer Expenditures, Incomes and Savings*, Statistical Tables Urban United States—1950, vol. XVIII, table 1.

⁵ Margaret G. Reid, "Patterns of Income Distribution," E. E. Hoyt and others, *American Income and Its Use*, 1954.

⁶ See U.S. Bureau of the Census, *Current Population Reports*, P-60, annual estimates, families by occupation of the head. The estimates pertain to median income.

⁷ The estimates shown are the mean ratios for 46 States for which income was reported for 1949. Similar data for 1959 for California and New York had not been released at the time this estimate was made. The data are from the *U.S. Census of Population: 1950*, vol. II, table 32, and *U.S. Census of Population: 1960*, vol. II, table 65.

² "Food and Agriculture Act of 1962," testimony of Secretary of Agriculture Freeman, *Hearings before the Committee on Agriculture*, House of Representatives, 87th Cong., 2d sess., on H.R. 10010, Feb. 7, 1962, p. 114.

The percentage increase in money income of rural farm families—that is, farm families other than those in urban areas—differs appreciably among States⁸ and, in general, the increase for farm families appears to have been held in check by a relatively high increase in the importance of the aged in the population. Increase in years of schooling appears to have been a positive force. The greater the increase in the average years of schooling completed, the greater the increase during the fifties in the money income of families. This tendency is common to farm, rural nonfarm, and urban families. It will support the current policies that increase in education and equalizing opportunity for education is a very effective means of promoting economic development. It should be noted that the average years of schooling is less for the farm than the nonfarm population. In 1950, for example, and average years of schooling of males 25 years of age or more was 8 for the farm, 9 for the rural nonfarm, and 10 for the urban population.

In addition, in 1960, 11 percent of the farm males 25 years of age or more had less than 5 years of schooling and only 3 percent had 4 or more years of college, whereas for the urban population the corresponding percentages are 7 and 8. In other words for adult males, 11 percent of those on farms and 7 percent of those in urban places had very low schooling, and 3 percent of those on farms and 8 percent of those in urban places had very high level schooling. These differences have a bearing on income since it tends to rise appreciably with years of schooling. Furthermore, between 1940 and 1960 an appreciable rise occurred in the average years of schooling of males 25 years of age or more, and within States the percentage rise was somewhat less for the farm than nonfarm population.

These measures of change in average income only indirectly represent what happened to farm families of 1950 who by 1960 were in the nonfarm population. This shift represented increased income for many, if not most, families. It seems important to note that between 1950 and 1960 the increased importance of nonfarm families is greatest for States where money income of farm families in 1949 was lowest.⁹ Among States, average

⁸ The variation among States in the rate of increase in income of farm families between 1949 and 1959 was affected by the extent to which income of 1959 represented the secular trend of the late fifties. (See "State Estimates of Farm Income, 1949-59," supplement to the July 1960 issue of *The Farm Income Situation*, Agricultural Marketing Service, U.S. Department of Agriculture.)

⁹ The correlation is as follows:

$$\log x = 2.59 - 0.17y \quad r^2 = 0.72$$

where y is the percentage of all families in the nonfarm population of 1960 with the corresponding percentage of 1950 equal to 100, and x is the median money income of the rural farm families of 1949. The estimates represents all of the 48 States of 1949, except California and New York. (Data for these were not available at the time the estimate was made.) The data are from the Census of Population of 1950 and 1960.

income of farm families of 1949 was lowest for Mississippi, and during the fifties the percentage of nonfarm families in that State rose from 53 to 77, an increase of 44 percent. The corresponding increase is 6 percent for the 26 States where average money income of farm families for 1949 was at least \$2,000. This implies that expansion of the nonfarm population was greatest in States which by 1949 had demonstrated that agriculture was likely to be less rewarding than a nonfarm occupation. The change made seems likely to have benefited both those who left and those who stayed on the farm.

The degree of equality of income is also important to any consideration of welfare and of the efficiency of a system in allocating resources. There seems reason to expect that native skills and abilities are so distributed in the population that increased equality of opportunity will tend to bring increased equality of real income. There is some evidence that the fifties brought some increase in the equality of income among rural farm families. Between 1949 and 1959 a greater percentage increase occurred in the average money income of rural farm families of States with low than with high average income in 1949. Estimates of such change are as follows:

*States ranked by money income
for 1949 of rural farm families
Average income of the States¹ for
1959 with that of 1949 equal to \$100*

Lowest fourth.....	\$207
Second lowest fourth.....	194
Second highest fourth.....	167
Highest fourth.....	168

¹ In these averages, each State has a weight of 1.

Thus, in the fourth of the States where average money income of families for 1949 was lowest, it rose 107 percent, and where it was highest it rose 68 percent. These tendencies reflect the effect of many changes: change in the volume of production per farm, their prices, off-farm work, and indirectly, too, shift of population from farm to nonfarm residence.

Many changes in income imply that during the fifties increases in income were widely shared. The information pouring in on income does suggest that attention to averages of farm and nonfarm average families of the Nation in general fails to take into account many important conditions. One of concern to agriculture is the marked inequality of average income of farm families among States. This inequality, although reduced during the fifties, is still great, much greater than that for nonfarm places. In addition, it is closely related to difference in educational levels. An examination of investment in human capital might contribute much to a further understanding of this income difference, to conditions that would contribute to economic development, to greater equality of real income, and to the mutual welfare of the farm and nonfarm population alike.

Discussion—Continued

Homer L. Brinkley

*Executive Vice President
National Council of Farmer Cooperatives*

THE EVOLUTION of agriculture in the United States from a primitive, local, self-sufficient way of life to a specialized, mechanized, commercialized type of business enterprise is a fascinating and complex story. It can be understood only as an inseparable part of the evolution of the entire U.S. economy because there is a vital, mutual, cause-and-effect relationship between changes in agriculture and changes in industry, distribution, and labor. These evolutions offered conditions whereby agriculture could make a great contribution to national economic progress. That contribution is well known to this audience. It was covered partly by our first speaker, Mr. Wallace, and, in greater detail, by the lecturers in the Centennial lecture series sponsored last fall by the U.S. Department of Agriculture.

Among the many institutions created by and used by farmers in making that contribution to economic progress are their marketing and purchasing and service cooperatives. Such cooperatives spring from an ancient and vital need peculiar to farmers—the need for group action to accomplish economic ends beyond the capabilities of any individual. Early colonial settlers (mostly farmers) became aware of and used the principle of cooperation by working in groups with their neighbors in many community projects. Without creating a new organization or using the term “co-operative” to describe these efforts, the farmers became acquainted with and dependent upon sound principles for organizing group action.

Group action takes innumerable forms and assumes innumerable functions. The sphere of action may range through the whole spectrum of human relationships. Our attention will be focused largely on the economic field. Group action among farmers in the form of the separate off-farm business enterprise began about 1840 in those sections of the country in which agriculture was shedding the clothes of self-sufficiency and becoming specialized and commercialized. As farmers began to produce goods for market rather than home consumption and began to require production supplies not furnished on the farm, they saw the need for group action in these fields. This process of commercialization brought farmers into more direct contact with the off-farm forces which were responsible for industrialization and urbanization of the economy. The commercialization of U.S. agriculture has proceeded continuously and rapidly up to the present time, and cooperatives have been an important institutional and economic factor in this development. The organizing and developing of farmer cooperatives represents a part of

the process of adjustment—both on and off-farm—to economic conditions created by a dynamic capitalism and concentration of economic power.

By means of cooperatives farmers have made a greater contribution and have served the public interest better than they would have in the absence of this type of organization. In the short time available to me I want to touch on some of the major ways in which, by means of cooperatives, farmers have been able to exercise economic influence that would have been otherwise impossible. They have, thereby, enhanced their contribution to economic progress.

Cooperatives and Balanced Economic Growth

Concentration of the U.S. public on the overall aspects of economic growth has consistently masked the unpleasant facts of imbalance in that growth. One imbalance existing is that farmers, as a group, have not enjoyed the same steadily rising standard of living as have other groups. In fact, their condition has become relatively worse. During the past decade, per capita farm income fell from 53 percent of nonfarm income to 43 percent of nonfarm income despite great improvements in productivity per man-hour, a great increase in capital investment, and the reduction in farm population of about three-quarter million persons per year.

Economic growth occurs when average per capita real income is rising. Balanced economic growth occurs when, in addition to this condition, no economic group has suffered a worsened position. Balanced economic growth would occur if the land, labor, capital, and management factors in each segment of society were rewarded in accordance with their productivity. Such balance occurs in a market-type economy only when there is equality of economic power and equality of economic opportunity among the various segments of society in competing for a share of the national income.

The fundamental cause of the low earning power or low economic power of agriculture is that the basic production units did not evolve in the same way as did production units in manufacturing industry, distribution, and organized labor. The structure of key nonagricultural sectors is one of relatively few large units. By contrast, agriculture presents a relatively small-scale type of structure. Instead of a few or even a few hundred firms producing the output of an industry we have, in agriculture, many thousands or over a million separate firms producing the major crop and livestock products. This contrast in size of

producing unit between agriculture, on one hand, and industry and labor, on the other, presents a paradox. Small-scale enterprises in agriculture are a source of national strength in terms of total output, production efficiency, and economic progress. But small-scale firms are a great weakness to farmers in today's economy in developing the competitive strength to earn fair incomes.

Agricultural structure and output.—One of the important measures of economic progress is total output in relation to total population. It is well known that, in spite of some acreage restrictions, agricultural output has exceeded population growth in the United States for many years and threatens to exceed it even more in the future. Many factors are responsible for the size of our total agricultural output, but among the most important is the economic structure of agriculture in small-scale, individual, entrepreneur enterprises. In such a business one individual, the farmer, furnishes labor, managerial, and capital inputs. This creates a compulsion to produce at full capacity which is irresistible. Agriculture is unique in the U.S. economy in producing at maximum output 52 weeks per year and selling this output for whatever it will bring in free markets.

Agricultural structure and efficiency of production.—Another important source of economic progress in a country is cost per unit of output or efficiency of production in each industry. Agriculture has an unequalled record here which is well known to this audience. It is measured in output per worker, in the falling real cost of a basket of food, or in the size of the labor force. Again, many factors contribute to this situation—a great national asset—but among the most important is the small-scale enterprise in which the individual farmer has been enabled to use maximum ingenuity, personal responsibility, and initiative in combining the factors of production.

Agricultural structure and economic power.—The organization of agriculture in millions of individual production units permits the development of only one element of economic power—that is, efficiency of production. Small-scale enterprises, existing alone, preclude the use of vertical and horizontal integration, large-scale mass production techniques, diversified product lines, extensive research for new products, use of consumer brands, sales and promotion programs, and, most important of all, industrywide programs to relate output to demand and to increase demand—all necessary elements of economic power and all developed skillfully by large-scale organizations. It is here that group action by farmers achieves its significance. Through cooperatives, farmers have been able to develop some of the elements of economic power yet retain the freedom, the initiative, and creativity of the individual enterprise. Insofar as the development of large-scale operations have raised farm income they have permitted farmers to improve their contribution to economic

progress. They are instruments for capital accumulation and for efficiency of production of farms supplies—efficiency of marketing and processing farm products. They have reduced the need for Government action or intervention in the economy to create a favorable competitive environment or to redress imbalances in economic power which would otherwise exist. Cooperatives offer a method for society to achieve the benefits of small-scale agriculture and, at the same time, achieve more balanced economic growth.

We recognize, of course, that, in spite of this notable contribution, a state of continuing imbalance exists. It is a great improvement over the state of peonage in which farmers would be without their cooperatives, but it is not an entirely balanced economic growth. Cooperatives have not been able fully to redress this imbalance and give farmers true equality of opportunity because of several inhibiting influences. Among them are the more rapid appearance and expansion of other forces of economic development. For example, the new production technologies, combined with unrestricted unplanned use, raised output far in excess of expectations and in excess of demand. Another is the expansion of economic strength of nonfarm business firms and organized labor. A factor retarding cooperative growth is the competition for capital for expansion and mechanization of the farm business operations.

Cooperatives a Bridge for Research

Public and private research has been an important force in the evolution of U.S. agriculture. This research yielded new production and marketing technologies. Cooperatives augmented the public efforts in research by sponsoring, financing, and utilizing research in support of specific business operations. Examples include the development of new products, new equipment, and new techniques. Cooperatives have augmented the efforts in education by disseminating, explaining, and applying research results to the practical problems faced by farmers. More resources oriented directly in putting results to work were employed.

Cooperatives a Bridge Between Farmers and Government Programs

Farmers' contribution to national economic progress has been supported and assisted by many nonresearch State and Federal governmental programs. Among these are laws to maintain fair competition such as the Perishable Agricultural Commodities Act, the Packers and Stockyards Act, etc. Other laws are designed to make the marketing system more effective. Among these are the Crop Reporting Service, the Price Reporting Service, and all State and Federal quality and grading services. Others more directly in the income and price stabilization field include Government storage operations of nonperishables and the

marketing agreement and orders program. Another important type is the Government-sponsored credit programs. Through their cooperatives farmers learn about these programs more quickly and are able to make maximum use of them. Some of these programs offer opportunities which are relatively inaccessible to farmers without the establishment of a cooperative business enterprise.

Cooperatives as an Instrument of Economic Education

In order for farmers or the producers in any industry to maintain their markets or "achieve business success" it is necessary that they produce, process, and sell those products which are most in demand. This demand changes rapidly as the broad forces of economic and social change appear. Among the most potent forces in the last decade are the great increase in consumer income, the shorter working week, the practically universal ownership and use of the private automobile, the prevalence of early marriages and large families, the increased number of women working, the replacement of servants in homes by electrical appliances, changes in the number, types, and activities of nonfarm business firms, etc.

Rapid adjustment to these and other nonfarm forces is essential in a market economy to contin-

uing favorable evolution of American agriculture. The kind of adjustment—such as adjustment through group action as compared to adjustment through efficiency of production—is of crucial importance today. Effective types of adjustment require the combined educational efforts of the government—State, Federal, and local—and of farmers' own organizations. Cooperatives have played an important role in this field because they can and have demonstrated the relationship between different products and different prices, the relationship between rising and falling demand for certain products with consumer tastes, and between changes in markets and types of buyers, etc., with prices received. This is the most persuasive type of education available.

Summary

By organizing and operating marketing, purchasing, and service cooperatives, farmers have been able to make agriculture a more effective force for national economic progress. They have done this by contributing to balanced national economic growth and a more beneficial competitive climate, by creating an effective bridge for the application of research, by offering a bridge between farmers and government programs, and by assisting and accelerating the economic education of farmers.

BANQUET

Introductory Remarks

Harold D. Cooley

Chairman, Committee on Agriculture, House of Representatives

THIS EVENING we look back upon a century. It is a century that, as no other 100 years in all history, embraces across these broad and bountiful lands of ours, the culminations and triumphs of the fundamental objective and aspiration of mankind—the freedom from hunger.

We are here to honor the people who *give us this day our daily bread*.

Perhaps to bring this World Food Forum into its proper character and perspective, we first should remind ourselves that the plow was the beginning of civilization. Of all ages, the plow is the greatest creation of the ingenuity and mind of men. It enabled man to quit his wandering in quest of food and to settle for the first time in permanent communities. The plow, by the best reckonings, appeared earliest in the Valley of the Nile, or the Euphrates. Plows that were used 2,000 to 4,000 years ago have been unearthed at the sites of old civilizations.

Colonists introduced the plow to North America and established civilization here. People, fleeing the feudal and baronial systems of Europe, then planted upon this continent the family farm system of agriculture.

This was the beginning of free enterprise in America. Indeed, the family farm established the economic base for popular rule—of government of the people, by the people, and for the people, in these United States of America.

This World Food Forum opens the Centennial of the U.S. Department of Agriculture, which was established by President Lincoln in the year 1862. The purpose of the forum is to assess the role of American agriculture in the light of its technological preeminence in the world today. The theme of the Centennial observations extending throughout the year will be one of tribute to the American farmer whose skill and progressive adaptation to technological advance has made the epic of our agricultural accomplishments possible.

I am honored to occupy this place before you and to hold this gavel, but I feel that not I but all the people of America are presiding here. I salute this occasion in such a presence.

There are here hundreds of distinguished agricultural scientists, educators, and administrators from all sections of the United States and a number of foreign countries. Many will speak in the course of this 3-day forum. In a moment we

shall hear an address by Hon. Orville Freeman, the Secretary of Agriculture, who will give these undertakings here proper dignity, importance, and wisdom.

Suffice it then for me, having traced briefly the fundamental relationship of food and civilization and our own beginning as a nation, to conclude by impressing upon this audience simply this:

Agriculture is America's largest industry, by far.

Our farmers have made us the best-fed nation on earth. Americans pay a smaller portion of their income for food than any other people anywhere.

Our food is feeding millions of friendly people in the four corners of the earth.

The productivity of our farms is the greatest stabilizing economic force in the free world today.

Food from our fields and pastures has defeated or checked communism in its tracks in great and important areas of the world.

Khrushchev rattles his missiles, talks about Russia's great industrial strides, but never does he boast of overtaking the American farmer.

Yet, for all this, our farmers are the poorest rewarded workers in this most prosperous nation on earth.

Mr. Chief Justice, this occasion, this Centennial, is a time to glorify the American farmer. It, moreover, is a time of challenge for the American people. The challenge is equity and justice for the farmer and his family. I, therefore, salute this occasion as a rededication to the purpose that these farm families who feed and clothe us be brought into equal partnership with other great segments of our national life, in the sharing and enjoyment of the rewards and blessings of free enterprise in this American capitalistic system. We shall not rest until such is accomplished.

I give you now our distinguished guests:

HEAD TABLE GUESTS

Earl Warren, Chief Justice of the Supreme Court
Guillermo Sevilla-Sacasa, Ambassador of Nicaragua and dean of diplomatic corps
Dean Rusk, Secretary of State
J. Edward Day, Postmaster General
Orville L. Freeman, Secretary of Agriculture
Allen J. Ellender, U.S. Senate
Ichiro Kono, Minister of Agriculture of Japan
B. W. Biesheuvel, president, International Federation of Agricultural Producers, Netherlands

George D. Aiken, U.S. Senate
Clinton P. Anderson, U.S. Senate
E. B. Evans, president, Prairie View Agriculture & Mechanical Arts College of Texas, Prairie View, Tex.
Clifford M. Hardin, chancellor, University of Nebraska, Lincoln, Nebr.
Matthew E. Welsh, Governor of Indiana
Elvis J. Stahr, Secretary of the Army
Henry A. Wallace, former Secretary of Agriculture

James Patton, president, National Farmers Union
Charles S. Murphy, Under Secretary of Agriculture
Fowler Hamilton, Administrator, AID
George McGovern, Special Assistant to the President
Jerome Wiesner, Special Assistant to the President
Herschel Newsom, Master, National Grange
Frank J. Welch, Assistant Secretary of Agriculture
Homer Brinkley, executive vice president, National Council of Farmer's Cooperatives

Allen J. Ellender

Chairman, Committee on Agriculture and Forestry, U.S. Senate

I REGRET that I have been denied the rare privilege of introducing the President of the United States. It is not often that one has this great honor.

The President advised me of his inability to be present this evening and he wrote me a letter dated this day, which I will read:

[The letter from the President appears on p. iv]

I wish to say "Amen" to the fine tribute the president has paid to our speaker of the evening, Hon. Orville L. Freeman, Secretary of Agriculture.

During my 26 years of continuing service in the U.S. Senate and on the Committee on Agriculture and Forestry, I became well acquainted with all the fine men who served as Secretaries of Agriculture in that time. None served with more devotion, with more energy, with more understanding, than Secretary Freeman. As Governor

of the State of Minnesota, he learned much in the field of administration, and he is vigorously applying his talents in the field of agriculture.

I know of no Secretary who grasped the problems confronting agriculture more fully and quickly than Mr. Freeman. And what I like about him is that he is trying to do something about those problems.

I know of no Secretary who has represented the farmers more completely than Mr. Freeman. He has made every effort to hold up the hand of the farmer and truly represent him. At no time has he tried to pit the consumers against the farmers.

This exceptional young leader is carrying the torch of the farmers and he is creating a fine relationship between the consumers and the farmers.

Distinguished guests, ladies and gentlemen, I now present to you our dynamic, active, tireless, and vigorous Secretary of Agriculture, Orville Freeman.

American Agriculture in a Changing World

Orville L. Freeman

Secretary of Agriculture

THE U.S. Department of Agriculture welcomes each one of you to this session of its World Food Forum. We are especially happy that the two chairmen of the Committees on Agriculture in the Congress of the United States have honored this occasion by accepting such essential roles in these proceedings.

Both Representative Cooley, chairman of the Committee on Agriculture in the House of Representatives, and Senator Ellender, chairman of the Senate Committee on Agriculture, have worked most effectively to sustain and strengthen the American agricultural economy in order that it may continue to make maximum contributions to progress in the United States and to world economic development. Mr. Cooley has given consistent recognition to agriculture as a major force in the world. Senator Ellender is one of this Nation's most vigorous advocates of international exchange of information and ideas, through direct, people-to-people contact, in the promotion of better relations. I wish to express my own per-

sonal appreciation, and the thanks of the U.S. Department of Agriculture, to these two men for their contributions to this occasion.

In scheduling this World Food Forum as the opening event in its observance of the Centennial of the U.S. Department of Agriculture, this Nation is affirming its recognition of the fact that problems of food and agriculture transcend national boundaries.

In tonight's consideration of "American Agriculture in a Changing World" we are particularly concerned with the difficult and urgent problems that accompany the revolutionary changes that are taking place in the world today. We recognize that the nature of many of these changes can be profoundly influenced by the availability of food in quantities adequate to meet human needs, and by the conditions under which that food is produced and distributed. We recognize that the tremendous success of agriculture in this Nation has placed us in a position of world leadership and world responsibility. We seek to meet that

responsibility by offering the maximum possible contribution by American agriculture to economic growth and higher levels of living, under conditions of freedom, throughout the world.

One hundred years ago, in 1862, three measures were adopted by this Nation that have made invaluable contributions to our agricultural productivity.

1. There was created in the National Government the Department of Agriculture, described by President Lincoln as "the people's department," to assist the farmers who then made up a majority of our population.
2. The Homestead Act was passed, to give renewed impetus to the principle of the family farm—the principle of ownership of the land by those who cultivate it—that has always been the basis of American agriculture.
3. The Morrill Act established our land-grant-college system, which has led the way in the application of research, experimentation, and scientific progress in agriculture. Under this program has been developed an extension system under which new science and technology could make a maximum impact on agriculture because it was made available to millions of individual farmers throughout the Nation, not only in schools and colleges but in their own communities and on their own farms.

From Scarcity to Abundance

These three measures, and the institutions that developed under them, had much to do with the century of progress that has seen agriculture in this Nation progress from an economy of scarcity to an economy of abundance, a progress that equals our greatest discoveries in atomic energy and outer space. Not only have we met the earlier challenge of making two blades grow where one grew before, but we have gone far beyond to develop an agricultural system whose abundant output is one of the great marvels of the 20th century.

The rise in productivity in American agriculture since 1862 can be measured in many ways. One of the most graphic is the number of persons supplied with farm products by one worker on the farm. One hundred years ago each farmer supplied $4\frac{1}{2}$ persons—including himself—little more than his own family. A half century later, in 1910, this number had increased to seven. By 1940 it was $10\frac{1}{2}$. In the decade between 1940 and 1950 the number increased to $14\frac{1}{2}$, with nearly all of the increase during the war years.

Since 1950 the rate of increase has sharply accelerated, so that the number supplied by one farmworker today is approximately 27. Fewer than 9 percent of our labor force are engaged in agriculture today, as compared with 20 to 40 percent in much of Western Europe, over 45 percent in the Soviet Union, and 70 or 80 percent in many of the underdeveloped parts of the world.

This agricultural progress has provided the people of the United States with an unprecedented abundance of food and fiber. It also has made a significant contribution to economic growth in other segments of our economy. To those emerging nations of the world that are today desperately seeking the industrial development that characterizes economic maturity, the contributions of agriculture to economic growth are especially significant.

As agriculture advances, the transfer of surplus labor from the farm to meet expanding needs for industrial manpower is most significant. Industrial development requires a substantial and steady expansion of the labor force available for manufacturing and other nonagricultural occupations. Statistics show a very definite correlation between the decline in the proportion of a nation's manpower devoted to agriculture and the achievement of economic growth.

Agricultural progress likewise contributes materially to the capital formation that is needed for economic growth, particularly in early stages of industrialization. And the increased demand on the part of farmers for industrial products is an important stimulus to industry.

Meanwhile, increased food supplies at relatively low prices mean that wage earners need to use less of their income to buy food. Thus their demand for other goods increases, and a rise in national output, income, and levels of living takes place.

In these and many other ways American agriculture has made a massive contribution to the economic development of the United States. Because such contributions are more critically essential in the pretakeoff and takeoff stages of economic growth than they are after maturity has been reached, the most dramatic contributions of agriculture to the economic growth of *this* nation lie in the past. Substantial contributions will continue, in the future, as a firm underpinning to our national well-being.

The most dynamic contributions to economic growth that American agriculture can make in the years ahead will be in the underdeveloped areas of the world.

A Revolution of Rising Expectations

This is particularly true because the "revolution of rising expectations" reflects one of the most critical aspects of the changing world of today. Only a minority of the world's people live in nations in which a mature modern economy provides high levels of living. In these nations food and fiber supplies are adequate, if not excessive. The benefits of modern science and technology provide comforts and luxuries in abundance.

But a majority of the world's people live in emerging nations, at various stages of development, in which scarcity of most of man's physical needs is a dominant characteristic. But the people of these nations desperately seek to achieve the

levels of economic well-being that they see in the economically advanced nations. Their drive toward that goal is determined and insistent, and cannot be denied.

Let me ask, at this point, just why we should be deeply concerned about economic growth in these underdeveloped areas? Basic human decency and morality impel us to care about those of our fellow men who suffer from hunger and want, but in addition to this there are other more mundane reasons.

First, our own security depends on the prevalence of conditions under which the people of underdeveloped nations can hope to achieve higher standards in peace and in freedom. If the underdeveloped nations can be helped to achieve satisfactory growth rates under free institutions, the security of the free world will be immeasurably strengthened. If they choose other institutions and other methods, freedom may be jeopardized even where it now exists. It is therefore very important that we do our utmost to assist their economic growth under free institutions, such as those that have meant so much to our own advance.

Second, our own continued economic growth demands rising standards elsewhere, among people with whom we hope to develop expanding trade relations. One might illustrate this aspect by pointing-out that you can't sell food to a man who has no money, no matter how hungry he is.

First you give him some food—either outright or on long-term credit. Then you help him find a job. Or, if no job exists, you help to create a productive job for him that will enable him to pay his own way and buy what he needs in the market place. This illustrates what we mean by food assistance and economic assistance. This is what we as a nation are doing under our Food for Peace and economic aid programs.

The contributions that American agriculture is called upon to make thus take two forms. One is in the form of Food for Peace, the program under which we have contributed \$9.5 billion worth of the products of our agricultural abundance to relieve hunger, meet emergencies, and promote economic development. We will continue to strengthen and improve this program.

American agriculture can also contribute—not only of the fruits of its productivity but also of the know-how that makes this productivity possible. For it is now well recognized that a revolutionary increase in agricultural productivity within the emerging nations themselves is essential for successful takeoff toward a mature economy.

Countries in Transition

During the transitional period, when a country is striving for industrial growth, the need for food increases. Rising population, the growth of cities, the increased demand on the part of hungry people whose low incomes are going up a little—all con-

tribute to the need for more food. The Food for Peace program helps to meet that need. But that need can never be fully or permanently met without a sharp increase in their domestic farm production.

To encourage such an increase in domestic productivity, technical assistance in agriculture is of utmost importance. Ever since President Truman announced the point 4 program, technical assistance has been a part of our foreign policy.

This technical assistance in agriculture has taken many forms. First there is the sharing of all kinds of technical and scientific knowledge relating to better farming—including such things as irrigation, soil fertility, the breeding and development of better field crops and farm animals. For more than a decade the Department of Agriculture has carried out a project for locust and other insect control in the Near East, South Asia, and parts of Africa, in cooperation with the nations in those areas and the FAO. More than 1,200 American technicians and experts are abroad, helping with projects ranging from the reclamation of waterlogged and saline lands to the raising of chickens.

But this kind of assistance has limited value unless it is accompanied by education for those who cultivate the land, unless it includes assistance in making the kind of social and institutional changes that will help bring about better use of both natural and human resources. We therefore offer technical assistance in the building of economic and social institutions under which economic growth can proceed in a free society.

Youth and Responsible Citizenship

One such example is found where basic principles of democracy, along with economic progress, are furthered by programs to assist in the organization of rural youth clubs patterned after the 4-H Clubs in the United States.

An objective of these clubs is to encourage responsible citizenship and provide rural youth an opportunity to participate in constructive group activities in addition to the specific projects undertaken by the members. The members are given special training in how to conduct meetings, and the parliamentary procedures involved. Interest in the 4-H Clubs can be illustrated by the fact that in Brazil, 200 clubs have been organized with over 4,000 members, Colombia has almost 600 clubs with over 9,000 members, Ethiopia 101 clubs with 6,000 members, Iran 600 clubs and 12,000 members, the Philippines 4,700 clubs with 116,000 members, Taiwan 5,300 clubs with over 65,000 members, Thailand 190 clubs and 7,000 members, and Turkey approximately 1,000 clubs with 25,000 members.

Another illustration of sharing the benefits of American agricultural know-how to build essential institutions is a program of supervised agricultural credit that was established in Iran to

make the land reform program work. In the past, the peasants, the backbone of an expanding economy, have been paying the equivalent of 50 to 200 percent interest for most of their credit. This is an obviously unbearable burden that throttled the aspirations of the peasants and aggravated social unrest. With the advice and counsel of American experts, a supervised agricultural cooperative credit program was launched, by which credit that costs the farmers only 6 percent is integrated with the supplying of fertilizers, improved seeds, and education to improve farming practices.

The achievements of the program have been most remarkable. To date nearly 1,000 credit cooperatives have been organized, serving nearly 300,000 members, or some 1,500,000 farm people. Loans to members have run between \$5 and \$6 million, and the share capital owned by the peasants and their savings amounting to approximately \$1.9 million. To encourage savings, the Agricultural Bank guarantees saving deposits made with approved cooperatives. In the midst of great poverty and waste, villagers have, with good guidance and trust in their cooperatives, responded to help themselves overcome one of their great economic burdens.

A key to the success of the cooperative credit program of Iran has been the training and educational activities of the Agricultural Bank. During the past 3 years, some 250 cooperative supervisors have been trained and employed, 120 field training seminars held, 2 countrywide seminars conducted, many educational booklets and guides issued, and 4 cooperative movie strips prepared. Without these educational and guidance activities, the cooperative credit program for the peasants would have been impossible. U.S. assistance to the Agricultural Bank of Iran has been limited to supplying American advisers and training some 12 Iranians in the United States. Total costs, from the beginning through next June, will be about \$200,000.

One cannot go into the villages of Iran where credit cooperatives have been organized without being impressed by the gleam of satisfaction in the faces of the peasants and sense their desires and aspirations to have more of the simple comforts of life—better food, clothing, security of tenure, and relief from excessive indebtedness.

Many other illustrations could be given of ways by which the institutional experience, under which American agriculture leads the world in productive efficiency, can contribute to the developing nations.

They include education at all levels: the training of scientists, of extension workers, and of the farmers themselves.

They include emphasis on research and experimentation.

They include the development of cooperatives through which farmers market their products and purchase supplies.

They include facilities for credit and the kind of supervised credit that makes for better management.

And they include a system of land tenure and private ownership of farms, under which efficiency and progress is stimulated by individual ownership and personal incentive.

The United States stands ready to assist the developing nations of the world in the know-how to adopt and adapt such institutional patterns as these.

Many of the emerging nations have not yet settled such questions as land tenure and ownership. Many of them face major problems in their search for agrarian reform.

An Age-Old Dream for Ownership

They feel impelled to choose the system of land ownership and cultivation that will bring about the increase in productivity they must have. And at the same time they face the rising clamor of those who till the soil for the age-old dream for ownership of the land they till.

In this single aspect of institutional development—calling for individual ownership of the land by those who cultivate it—may lie a major key to the future political and economic development of many nations. It has been a major factor in our own development.

More than a century ago Daniel Webster declared that "A Republican form of government rests not more on political constitutions than on those laws which regulate the descent and transmission of property."

Political and social development in most of the emerging nations will be materially affected by the institutions that grow in the rural areas where most of the people live. If land tenure reform follows the pattern of individually owned and operated family farms, free institutions will be immeasurably strengthened.

Furthermore, all evidence we have indicates that both capital formation and increased agricultural productivity will be enhanced by this course. In an underdeveloped agriculture the incentive of ownership is a powerful mechanism for the creation of capital from labor by such means as digging wells and ditches, clearing land, building roads or terraces or buildings, and rearing livestock. Underemployed labor is thus transformed into capital assets. This impetus to productivity is not achieved where the farmer lacks the pride of ownership and the opportunity for gain from his added effort.

On the other hand, repudiation of the principle of farmer ownership of his land has had serious results. Recent history shows what an appalling price in hunger, food deficits, and lagging productivity has been paid where governments have sought to destroy individual incentive and ownership in agricultural production.

Recent history also shows most promising increases in productivity where the family farm principle has been strengthened. When American assistance in Taiwan helped to increase the percentage of farmland operated by its owners from 57 to 87 percent, productivity increased by 51 percent in only a few years. When farm tenancy in Japan was reduced from 46 percent of the arable acreage to 10 percent, production per cultivated unit increased 44 percent even though the size of such units had been reduced. Total agricultural net real income increased by 32 percent.

To those nations and peoples who face this choice, American agriculture can issue a challenge. No feudal estate, no state-owned farm, no plantation, no latifundio, no collective—no one of these has ever achieved the abundant and efficient productivity of the American family farm. No one of these has ever produced an agricultural economy that has contributed so much to overall economic growth. No one of these has ever equaled its development of a level of citizenship and sense of personal dignity and worth.

This is a part of the know-how that American agriculture offers to contribute to this changing world.

When I opened this forum earlier today, I stated that the highest purpose of this Centennial observance is to evaluate the achievements of the past in terms of the needs, opportunities, and challenges of the future.

We are proud of—and thankful for—the achievements of American agriculture in the past hundred years. As we review those accomplish-

ments it becomes clear that the knowledge, experience, and resources that we have developed during that century can contribute materially to meeting the needs and solving the problems of the years ahead. American agriculture can play a major role in this Nation's effort to cooperate with all other nations that seek the same goals, in striving for a brighter, more secure future on this earth.

American agriculture is in a position of leadership. As a result of that position it has an obligation to lead in the direction of the maximum utilization of the scientific and technological revolution of today to bring about the economy of abundance that is possible in the world of tomorrow.

I should like, in closing, to repeat the same emphasis on the task ahead that I made this morning at our opening session.

As we seek to meet the challenge of this new age of space, of power, and of potential plenty, we must adapt our social and economic institutions to direct the power that man has created in the best interest of mankind. The future of our entire civilization may depend on how well we succeed.

Let us resolve to meet that challenge.

Let it never be said that, in these critical years of the scientific revolution, we were able to send men into space—but unable to put bread and milk into the hands of hungry children.

Let it never be said that we had the scientific knowledge and the technical skill to produce power sufficient to destroy civilization, but that we did not have the ability, the vision, and the will to use that knowledge to produce and distribute the abundance that science and technology now offer to a world at peace.

SECOND PLENARY

In this second plenary session we examine trends; trends as they apply to man and his food. How fast are people multiplying and what about their food supply? Attention is focused on: (1) the recent advances in agricultural technology; (2) an exchange of views on current and emerging problems; and (3) how best to get advanced techniques applied where needed.

WORLD AGRICULTURAL TRENDS

Trends—An Introduction

Edward B. Evans, Chairman, *President, Prairie View A. & M. College, Texas*

To SET the stage for this forum, may we ask ourselves two simple but far-reaching questions?

First, what are the nature and extent of the current and emergent world population, food, and nutrition problems, and what can we, or must we, do with the knowledge and insight we shall acquire today?

Second, are there too many people in the world?

Is there enough food to give them all hope for health and happiness?

How long will the population explosion last?

How will we harness sufficient equipment, and personnel, to apply the techniques necessary for adequate food production, distribution, and consumption in the less-developed countries?

That there is a population explosion can be seen without elaborate statistical surveys. As the Director of Census of this country points out, three babies are born every second somewhere in the world today. If present trends continue, we shall have 400 million people in the United States and 862 million in India by the year of 2005.

There are sharp contrasts in the foods and diets of nations of the world.

The World Food Budget: 1962 and 1966 reveals that diets are nutritionally adequate for one-third of mankind. These 900 million people live in the 30 industrialized nations of the temperate northern area. They either produce or import enough

food for their needs at the present and for the foreseeable future. But, the 1.9 billion people in the 70 less-developed nations in the southern area do not produce and import enough nutritious food. There is no hope for a decent standard of diet for many millions of these people.

Their plight is the crux of the problem of imbalance between population trends and production trends.

What are these trends in these two very different areas?

How available to them is the storehouse of scientific and technical knowledge?

What proportions of their people are skilled enough to operate the machines and tools which might be provided?

Is there sufficient fertilizer? Energy? Money?

What geographical and cultural factors cause severe fluctuations in production?

In death rates and birth rates?

In tastes as well as dietary needs?

Now, ladies and gentlemen, you want answers to these and other questions. Fortunately, your chairman does not have to provide them for you. For this task, the World Food Forum Committee selected experts from among the most competent men in the world.

As chairman, it is my pleasure to present three outstanding persons in the area of world population, food, and nutrition.

World Population Trends

Frank W. Notestein

President, The Population Council, Inc.

IN 1944 the Harris Foundation of Chicago University devoted its annual conference to agriculture and the proceedings were published under the title "Food for the World" edited by Prof. Theodore Schultz.¹ My assignment at that conference was the same as it is here—to discuss the future trends of world population. If I had taken the trouble to reread my paper before responding to the invitation to speak here, I would not have had the courage to accept. If your organizing committee had read it, I would not have been asked. The earlier paper was called "Population—The Long View," but so far as the projected numbers were concerned it would have been better called "Population—The Wrong View." You are therefore listening to a forecaster who has been grossly wrong in the past and who has no reason to think he can be more accurate now.

It is useful to consider past mistakes briefly as a guide to our thoughts about the future. The errors were huge—even the orders of magnitude were wrong. My current best guesses for the world by major regions in the year 2000 range from about 35 to 170 percent above those given in 1944. North America, Europe, and Africa are already ahead of the values then projected for the year 2000. Asia and the world as a whole are now projected to pass the earlier figures for the end of the century about 1965; Central and South America before 1975; and the Soviet Union before 1980.

Now bad as these attempts to foresee population trends were, they were not particularly bad as such work goes. Nor is this kind of error in projection confined to the field of population growth. I suspect that even forecasts of agricultural production have less than a perfect record.

Prediction Is Unavoidable

If this and all other attempts to look ahead are so inaccurate, why should be bother? One answer is that prediction is unavoidable. We must take action now in relation to the future. The problem is not that of forecasting with precision. It is to portray the future with sufficient clarity to lead to correct choices in matters of policy. From this point of view the burden of my former argument correctly indicated that even a conservative estimate of future population growth made it clear that gigantic efforts were needed to speed agricultural production, particularly in the world's

poorest areas. The magnitude of the problem was grossly underestimated as, fortunately, were also the forthcoming gains in agricultural production. Subsequent experience has confirmed the importance of the opening remarks in my early paper, from which I quote:

Perhaps the greatest hazard in the way of forecasting population trends has been the disposition, both of the makers and of the users of predictions, to treat population growth as an independent variable; to view growth as a dynamic response to laws of nature moving irresistibly toward an inevitable goal. From such trends economic and political conclusions of great weight are readily drawn. It is no less true that population growth itself is a dependent variable, to be affected in large degree by the technological, social, economic, and political developments of the future. The nature of population growth will affect, and in turn be affected by, coming events. We too often fail to consider the response of population growth to the changing setting. . . . The difficulty . . . is not that of making predictions in terms of the present, or a reasonably anticipated, setting. Rather, it is that of taking the predictions too seriously once they are made. Having introduced assumptions concerning the governing conditions, we must constantly keep in mind the fact that they are assumptions and that a different course of events would lead to different answers.²

What then went wrong with these and other population projections of the war and postwar period?

In the first place, the expanded and improved census coverage of recent years has shown that the population of Asia and Africa were underestimated, so that future values were derived from too small an initial base.

The main source of error, however, lay in our failure to anticipate the spectacular reduction of mortality, which has been almost universal. It has transformed the modern world. For example, on the 1959 life table for the United States, a newborn white girl has a better change of living to 60 years of age than she had of reaching age 5 on the life table for the years 1900 to 1902.

Recent reductions of death rates in the underdeveloped areas are even more spectacular, for they have taken place under minimal conditions of living, sanitation, and medical care. It is hard to believe, but true, that the crude death rates of Ceylon, Singapore, Taiwan, and many Latin American countries are lower than those of England and France. Of course, their health is not better, nor are the risks of death, age for age, as low. The numbers of total deaths for each thousand population are smaller simply because their populations are much younger than those of

¹ Notestein, Frank W., "Population—The Long View," *Food for the World*, Edited by Theodore W. Schultz, University of Chicago Press, Chicago, 1945, pp. 36–57.

² *Ibid.*, pp. 36 and 37.

Europe. The populations of technologically underdeveloped countries are young because they have very high birth rates.

The range of death rates throughout the world is rather narrow. Countries with good health tend to have low birth rates and old populations that lift their death rates. Underdeveloped countries, on the other hand, have higher risks of death but also have high birth rates and young populations that tend to lower the death rates. The result is that the range of death rates in the modernized countries and the main countries of Asia and Latin America is between 7 and about 25 deaths per 1,000 total population. Moreover, the lowest death rates are now in the underdeveloped areas.

These reversals in the order of death rates could not have taken place if the risks of death also had not declined spectacularly. Even in India, where efforts in the field of public health are scarcely more than well launched, the expectation of life at birth has risen from the middle twenties to the low forties in the last 40 years. Most of the gain has come since the end of the war. In more advanced medical situations such as those of Ceylon, Singapore, and Taiwan, life expectancies at birth are now in the low sixties, or about the same as they were in the United States 25 years ago.

Disease Control, a Major Reason

The risks of death in the underdeveloped countries have been declining at from three to five times the speed with which they declined through similar levels in Europe during the 19th century.³ These unexpected gains in conserving life have come from the control of contagion and infection by the use of modern insecticides, sulfa drugs, and antibiotics. Failure to anticipate the power of these scientific and technological achievements in controlling disease is the major reason for grossly underestimating the rate of population growth everywhere—but notably in the underdeveloped countries.

On the side of fertility, our mistakes were of a different sort. The predictions for the technologically underdeveloped areas were fairly accurate since nearly everyone assumed correctly that there would be little decline in birth rates for several decades. The major difficulties occurred in the developed countries. In Western Europe, the United States, Canada, Australia and New Zealand, most forecasts, including mine, were that birth rates would drop sufficiently to yield a period of slowing growth or even population decline.

In Western Europe, after a postwar rebound, birth rates have settled down to much the same level as in the prewar period. Recently there has

even been a tendency for them to rise again. In the United States, Canada, Australia and New Zealand, birth rates rose sharply and have remained substantially above the prewar levels. In the United States this rise has led to a rate of population growth sufficient to double our population in 40 years if it is continued.

Before the war it was not clear where the decline of the birth rate would stop in populations that were able to plan their family size efficiently and were thoroughly imbued with the values of modern urban industrial life. Before the war such populations had for some time reproduced at levels that eventually would produce declining numbers. The interesting fact is that, at least in the United States, it has been precisely these urban sectors of the population that have lifted their birth rates most. There has been little indication of a return to the large family. Most of the rise of the birth rate has come from a reduction in the proportion of women remaining single, and of childless and one-child marriages. The major effect has come from the increased proportions of two-, three-, and four-child families.

The postwar experience in the United States suggests that, in suitable circumstances of prosperity and domestic contentment, populations which mainly plan their family size can produce birth rates of 25 per 1,000. In short, the postwar experience of America has exploded the idea that populations which regulate their fertility by voluntary choice will not grow. In the United States we are growing now at rates that Western Europe seldom reached in the 19th century.

It is in southern and eastern Europe, the U.S.S.R., and Japan that populations have grown more slowly than expected. Our earlier projections forecast reductions of fertility for these areas, but the decline has been more rapid than expected. It is hard to realize that the Soviet Union, whose prewar birth rate was more than double that of the United States, now has a birth rate about the same as ours. It is equally hard to realize that in all Europe, only Albania has a higher birth rate than ours, and that Hungary and Japan are now among the countries with the lowest human fertility in the world.

Family Size, a Personal Choice

Undoubtedly the mixture of mounting aspirations on the part of increasingly educated and urbanized populations, on the one hand, and of difficult economic circumstances, on the other, have been the motivating factors. The means by which the rapid reduction of fertility have been brought about have been insufficiently studied. There is, however, no slightest indication that the physiological capacity of the population to reproduce has done anything but improve. All evidence suggests that the trend is the result of personal choices in matters of family size. The fact that abortion has now been legalized in Japan and throughout

³ Stolnitz, George J., "Comparisons Between Some Recent Mortality Trends in Underdeveloped Areas and Historic Trends in the West," *Trends and Differentials in Mortality*, The Milbank Memorial Fund, New York, 1956, pp. 26-34.

all of the Soviet bloc except East Germany, suggests that abortion at least in those areas has played a major role. Undoubtedly it is important in other countries as well, where other forms of regulating fertility are more prevalent and more efficiently used.

The net result of these errors in forecasting population 20 years ago was to understate greatly the coming growth and, therefore, the future problems of agricultural production. Fortunately, however, the possibility of lifting agricultural production was also underestimated. The result has been that in the past 20 years the food supply has for most of the world's people not deteriorated and, indeed, has probably improved a little.

Alas! another way of saying the same thing is that, because of mounting rates of population growth, the spectacular gains in agricultural production have been mainly absorbed by the requirements of additional population, rather than contributing to a rapid improvement of the world's nutritional status. We have avoided major tragedy, but in spite of miracles of production we are still facing a world in which the vast majority of the population is often hungry and always malnourished.

In the light of the postwar experience, what now seems to be the prospect for future growth? Barring nuclear holocaust, there is every reason to expect continued rapid population growth to the end of the century—perhaps fairly constantly at annual rates a little above 2 percent. If so there will be about 4.6 billion people by 1980 and 6.9 billion by the year 2000. These figures exceed the “high” projections issued by the United Nations in 1958.⁴ They are about a quarter of a billion higher in 1980, but are about the same for the year 2000.

In deference to convention, an appendix table gives a set of guesses for the world by continents to the year 2000 by 5-year intervals. This table is not the result of carefully worked-out projections showing the consequences of specifically formulated assumptions. It represents nothing more than the result of personal guesses about the rates of population growth between 1960 and 2000 for the major continents. The advantage over the projections issued by the United Nations is only that they begin with better estimates for the year 1960 and incorporate more of the postwar experience with vital rates. However, the figures reveal no more than the discussion that follows.

In America north of the Rio Grande, Oceania, Europe, and the Soviet Union, growth is expected to remain fairly rapid, with the rates for these regions converging somewhat. This involves slight declines for Northern America and the Soviet Union, and a slight rise in the rate of growth for

Europe. The rise reflects mounting prosperity in that part of the world where fertility is now most firmly under control. Such a course of events gives for the continents that are technologically rather well developed the following totals by the year 2000: Europe, 627 million; the U.S.S.R., 406; Northern America, 392; Oceania, 33; or a total of 1.5 billion in an area that in 1960 contained less than 900 million. In 1960 these regions had about 29 percent of the world's total, whereas, on these guesses, they would have only about 21 percent of the total by the year 2000.

Still Room for Improvement

America south of the Rio Grande is the world's most rapidly growing major region. It has some of the highest birth rates and, although health is improving, there is room for a further substantial reduction of death rates. The dominant religion disapproves of the simpler and more effective methods of birth control now available, and many of the countries welcome growth as a national asset. For these reasons I have guessed that the rate of growth will rise from the present 2.7 percent to above 3.0 percent before 1980 in Central America, and from 2.4 percent to about 2.8 percent in South America.

It is difficult to imagine that growth will continue very long at such extremely high rates in a region that is heavily urbanized and modernizing rapidly. Indeed in Argentina, Uruguay, and Chile, birth rates are already far below the maximum. Moreover, in the future the means of regulating fertility will be much more acceptable and effective than they are now. I have, therefore, assumed that the rates of growth will drop sharply after 1980 and reach 2 percent by the year 2000. This is a sharp reduction, but even so it leaves the region with a rate of growth at the end of the century which, if maintained, would double the population in 35 years.

By the year 2000 such a course of events will bring the population of Latin America to about 600 million, a figure a little less than three times that for 1960. The “high” United Nations projection yields a little more than a threefold increase by 2000.

For Africa, on the other hand, it is supposed that organizational problems will be an obstacle to rapid development, checking somewhat the quick control of death rates and the development of interest in family planning. We have assumed that the rate of growth will mount from 2.0 percent in 1960 to 2.5 percent in 1980 and to 2.7 percent in 2000. Such a course of events carries the population from 254 million in 1960 to 676 million in 2000. The value is 13 million above the United Nations “high” projection.

In Asia the expected course of growth is different from that suggested either for Latin America or Africa. Instead, we have lifted the present

⁴ *The Future Growth of World Population*. Population Studies No. 28, Department of Economic and Social Affairs, United Nations, New York, 1958.

2 percent rate of growth to a little above 2.5 percent before 1980, and then dropped it sharply to 1.7 percent by the year 2000. Implicit in this is the assumption that until the end of the century, Asia will expand its agricultural production at least as rapidly as its population. The rates of growth have been lifted to 2.5 percent by 1980 in the expectation of substantial gains in health offset by rather small declines in birth rates.

The assumed reduction of the rate of growth to 1.7 percent by the year 2000 is based on the fact that in this densely settled continent, rapid population growth is perhaps the major obstacle to economic development. This fact is already recognized by the Governments of Pakistan, India, Japan, and Korea, and the beginning of interest in regulating fertility is evident in Ceylon and Nationalist China. The position of Communist China is not entirely clear, but there has been enough vacillation already to suggest that there will be renewed interest in birth control as the pressures mount. Attempts by government to spread the practice of birth control by more effective measures than are now available are expected to reduce birth rates rapidly in the last two decades of the century.

This course of events would carry Asia's population from 1.7 billion to 2.7 billion in 1980 and 4.2 billion by the year 2000. The figures are some 212 million above the United Nations "high" projection for 1980 but about 62 million below that for the year 2000. Our figure for 2000 is 2.3 times the population in 1960.

If the course of growth were to follow the guesses of this paper, the "underdeveloped continents"—America below the Rio Grande, Africa, and Asia—which contained 71 percent of the world's people, in 1960, would contain 5.5 billion or 79 percent of the world's 6.9 billion by the year 2000.

Shall We Guess High, or Low

It should be observed that these guesses present an "optimistic" case since they imply sharply falling rates of growth in both Latin America and Asia before the end of the century. These falling rates are expected to come from reductions in birth rates in a context of improving health. Even so the growth is tremendous. The guesses imply that between 1960 and the end of the century, the population of the "underdeveloped continents" will be growing at an average of 2.3 percent compared with 1.3 percent for the "developed continents," and have 2.5 times as many people as they did in 1960. To develop these economies while carrying such a load of population growth will be a staggering task.

So much for the arithmetic, but what does it mean? Where are we likely to go wrong this time? It is possible, of course, that we have been

too optimistic in supposing that agricultural production will increase at least as rapidly as population until the end of the century. Perhaps, also, contagion will be less easily controlled than we have supposed. Perhaps political disturbances will break through the narrow margins that now protect the public health. Nevertheless, we had better plan than the world can be successful in protecting its health. Unless health is improved, none of our hopes for economic development will be fulfilled.

It is possible too that birth rates may drop faster than has here been supposed. They will not do so automatically, but the prospects seem good that there will be a growing realization in the regions involved that their earnest hopes for progress may well turn on speeding the regulation of fertility. Moreover the prospects are excellent that we will shortly have vastly improved methods for regulating fertility. Nevertheless, it would be irresponsible on my part to suggest we can plan for a world with much less than 7 billion people by the year 2000.

The meaning of the situation seems clear to me. Any decent respect for the future of mankind must lead us to plan for mounting rates of population growth in the technologically underdeveloped areas where poverty is now deep. Our plans must be based on this proposition. But it is equally important to realize that the changes for successful development would be greatly enhanced if birth rates could be much more rapidly reduced than they are likely to be unless active attention is given to the problem. Small reliance should be placed on the particular figures given here concerning the future population, but it is difficult to imagine the developments that would vitiate either of these conclusions.

These propositions conclude the formal assignment, but two matters of major importance will not be suppressed.

One is the plea that persons and institutions interested in population and agriculture realize that their activities are complementary. Too often their attitude has been almost competitive. A few people claim that our only hope of meeting the problems of poverty lies in their own area of endeavor. A few agriculturalists of this persuasion imply that reductions in the rate of population growth are unnecessary because an ideal application of existing knowledge would produce an unheard-of abundance of food. On the other side, a few enthusiasts for birth control assert that, prior to a reduction of birth rates, all gain in production will result in more population rather than more prosperity. The whole truth of course lies in neither camp. Spectacular gains in agricultural production are needed to buy the time necessary for a reduction of the birth rate, and such reductions will be essential if we are to mini-

mize the risk of failure in the field of economic development. The attack on poverty requires not only great increases in production but also an early reduction in the rate of population growth.

The final plea is that we stop talking about a race between world population and world food supply. The real issue is different, and such talk makes the problem sound both too dismal and too distant—dismal because it represents our aspirations in minimal terms of survival, and distant because it will be a long time before the world has more people than it can support at minimal standards by a modest application of existing knowledge.

The real problem is much more immediate and much more important. The only hope that all men can secure adequate health, education, and relief from poverty lies in escape from a self-sufficient peasant agriculture. We must rely on modern technological knowledge and a sophisticated use of resources. Men cannot, otherwise, obtain a decent livelihood even for the present population—to say nothing of the much larger populations of the near future.

The Transition Is Not Simple

The transition to technological modernization is not simple. It requires heavy investment in health, education, and productive equipment. The costs are high. They are particularly heavy when they can be met only after meeting the heavy costs of expansion required to support rapid population growth. Moreover, these combined costs of growth and modernization face societies that are so poor that savings represent acute hardship.

These problems are not distant; they are those of the next few decades; and they are urgent beyond belief. Let us, therefore, stop talking as if we were dealing only with a distant avoidance of starvation. Our sights must be much higher. We must secure the transition into a world of healthy, educated, and productive people able to meet life's hazards. Our prospects for success will be greatly increased if in the next two or three decades, reductions in human fertility can begin to ease the burden of population growth. This problem is immediate and urgent. On its solution may well rest all our other hopes.

Appendix

Note on Guesses About Future Population Trends

In 1944 my colleagues and I at Princeton's Office of Population Research produced for the League of Nations⁵ a book concerning the future of Europe's population.

⁵ Notestein, Frank W.; Taeuber, Irene B.; Kirk, Dudley; Coale, Ansley J.; and Kiser, Clyde V., "The Future Population of Europe and the Soviet Union," *Population Projections 1940-1970*, League of Nations, Geneva, 1944.

In it we suggested that the term "population projections" be used to identify models of population growth that illustrate specific sets of assumptions about the nature of the governing factors. We suggested these projections or models might well be distinguished from attempts to predict the actual course of events. This distinction has now some acceptance in demography.

The following figures do not deserve the title of "projections" in the above sense. They are produced so simply and subjectively that they are nothing but personal guesses of a rough-and-ready sort. They will nevertheless do as well as any other series as a basis for discussion of our present views concerning the future paths of population growth.

Such guesses are produced instead of more sophisticated models mainly to save time. But partly to leave the complicated task of constructing international projections to the United Nations. The existing United Nations series is badly in need of revisions.⁶ The "high" values would be plausible if they were adjusted to incorporate the new information about Asia and Africa in 1960, and rates of population growth more nearly like those now existing in North America.

The guesses given in the table were obtained as follows: Annual percent rates of growth for the population by continental groupings were noted as of 1960. Comparable values were then set down for the years 1980 and 2000 reflecting the guesses of the writer. For example, it is doubtful that Africa will be well enough organized to attain minimum mortality by 1980, or that much reduction of fertility can be expected by 2000. A rising rate of growth was therefore assumed. In Latin American the growth rates are very high, but there is room for expansion. The rates of increase are likely to remain very high, but to fall off a good deal about 1980. In Asia, on the other hand, improvements in health will probably continue to lift rates of growth until 1980, but then the high density of population will lead to public concern, as it already has in major parts of the continent, and systematic efforts to initiate the reduction of fertility will probably be made. By the year 2000 it is expected that growth will be reduced to levels now characterizing the United States and the Soviet Union. Among the developed continents some convergence in the rates of growth is expected. The values used are as follows:

Continent	Assumed Percent Rate of Growth in—		
	1960	1980	2000
Africa-----	2.0	2.5	2.7
Northern America-----	1.8	1.7	1.6
Central America-----	2.7	3.0	2.0
South America-----	2.4	2.8	2.0
Asia-----	2.0	2.5	1.7
Europe-----	.7	1.0	1.2
Oceania-----	1.7	1.8	1.7
U.S.S.R-----	1.7	1.6	1.5

The values for annual rates of growth at these three points were then connected by an equation with three unknowns. The constants of these equations were then incorporated in an exponential of the form

$$P_t = (P_{60})e^{at+bt^2+ct^3}$$

No virtue is suggested for this procedure, except that it is sufficiently precise so that the reader can readily substitute the values for his own guesses about the rates of population growth in 1980 and 2000.

⁶ *The Future Growth of World Population*. Population Studies No. 28, Department of Economic and Social Affairs, United Nations, New York, 1958.

POPULATION GUESSES

[Millions]

	1960	1965	1970	1975	1980	1985	1990	1995	2000
Africa-----	254	282	315	354	400	454	517	591	676
Northern America-----	199	217	237	259	282	307	334	362	392
Central America-----	66	76	88	102	119	138	158	179	201
South America-----	140	159	181	209	240	273	314	355	396
Asia-----	1,679	1,869	2,099	2,376	2,692	3,044	3,426	3,789	4,188
Europe-----	427	443	462	483	507	534	564	597	627
Oceania-----	16.5	18.0	19.6	21.5	23.5	25.7	28.1	30.7	33.4
U.S.S.R-----	214	233	253	275	298	320	346	374	406
World-----	2,996	3,297	3,655	4,080	4,562	5,096	5,687	6,278	6,919

World Food Production Trends

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UP TO ABOUT 1850, we may assume, world population and world food production have been running parallel, with local gluts and famine, but with no trend toward divergence, either world-wide or by region. There always have been differences in per capita production, on the basis of a bountiful or harsh nature.

The history of a world food production trend, therefore, is no more than a century, and we must ask ourselves—is there a world trend? Can we extrapolate from recent experience? Can one discover variations in movement between regions or continents? What seems a tremendous change in one area is considered commonplace in another, and vice versa. A comparison on world scale, therefore, is desirable.

Before trying to qualify some of the more striking phenomena, some qualitative changes need our attention.

Around the middle of the 19th century, change came with inexpensive massive ocean transportation, the steam plow, and the combine. Together, these made available for mankind cereals from the endless grasslands in the semidry temperate zones. North America, Russia, Argentina, and Australia thus made possible a slowly improving diet for a small part of the world's population. A few decades later, the Tropics added sugar and vegetable oils to the diet of the common man in the industrializing countries.

These developments, firmly entrenched in the pattern of food production and world trade by 1914, had a strong impact on our image of the world. Modern Europe was the main food-deficient area, at the same time exporter of industrial products, the provider of capital, and the protector of the trade routes of the world. All continents contributed to the needs of food and fodder of Europe—with cereals, including rice

from Asia—with meat, butter, sugar, fats, and oils. In addition, Europe was the main market for fibers, tobacco, tea, and cocoa. Still, in the minds of many people, it seems only natural that the highly industrialized countries import most of the food and agricultural raw materials.

At present, this picture has profoundly changed and, most likely, a new pattern has been set, perhaps for a long time to come.

North America, the Big Storehouse

The big storehouse for agriculture has become North America. Europe has stabilized its imports in spite of higher consumption. There is talk of a reorganization of the industrial countries of Europe. At the same time, the tropical and many subtropical low-income countries take a considerable part of world imports of basic food commodities.

The causes for these changes are complex. Some were operative as from the First World War and became noticeable during the big depression. Government measures in Europe and North America in the thirties, during the war, and since 1946 have accelerated the movement.

Still, there is a basic static element in this changing trend—the simple, monotonous, and deficient diets for the bulk of the population in the low-income countries, perhaps for two-thirds of the world's population. There cannot be, under these circumstances a great discrepancy between population numbers and aggregate food consumption.

However, there are striking changes in the underlying forces. In societies where the world's privileged consumers live, until recently, population increase was faster than among the underprivileged consumers. This basic demographic parameter has been drastically changed. The

turning point, as in so many other instances, is World War II. Decrease in mortality rates is the main cause for this reversal of trends. In most high-income countries, birth rates have increased rather than declined.

A factor, operative on the side of consumption, has been a relative decline of consumption of starchy foods in high-income countries.

On the production side of the ledger, the changes have been just as striking. Rising productivity per acre through the application of agricultural science and technology took a firm hold of northwestern Europe around the turn of the century. In North America, and southern Europe, this upward trend became noticeable around 1925, and has accelerated in a conspicuous manner ever since.

On the other hand, outside of North America and Europe, yields per acre have been rather static, with notable exceptions in Egypt, Japan, and Taiwan. Finally, two factors must be mentioned which have operated strongly during the last 20 years but now have lost force, as we all hope. World War II and its aftermath resulted in a decrease in food production in those countries which were the main battlefields. Especially in Asia, some countries are still suffering from these war tragedies. In South America, especially in the southern cone, agricultural production has lagged, partly because of long distance from traditional markets, partly because of development policies adverse to agricultural exports.

If this is a bird's-eye view of forces which underlie and perhaps determine trends, can their effect be quantified? In this respect, everything depends upon the availability and reliability of production statistics. I have made use exclusively of the yearbooks on agricultural production of the Food and Agriculture Organization of the U.N. and must rely on the valiant effort by a large group of statisticians over a long period to provide us with the data. If sometimes the outcome is startling, it would require detailed intensive international co-operation to make the data more comparable.

A Look at the Major Regions of the Free World

First of all, let us have a look at some basic aggregates, published by FAO for the major regions of the non-Communist world. Here, for comparison, I have selected the years 1950 and 1960, with the prewar period 1934-38 as a base. The order of the regions I have taken is the order of increase in food production in 1960.

This little table indicates the most rapid rise in food production in the Near East region. Asia and Oceania increased more slowly than other parts of the world. For Australia/New Zealand, marketing problems (long distance from Europe, low purchasing power in Asia) undoubtedly slowed down agricultural production. For Latin America, the decline in per capita production was

caused by rapid population increase rather than slow increase in aggregate production. Western Europe did well on a per capita basis, mainly because of slow population growth. Africa, having made rapid improvement during the first half of the period, fell back to a precise parallel between production and population. Asia and the Far East, in view of its high number of inhabitants and slowly increasing production, seem to pose the most serious questions.

Region	1950		Per capita production
	Aggregate production	Population	
Near East.....	144	127	113
North America.....	152	127	120
Latin America.....	135	145	93
Africa	141	128	110
Western Europe.....	123	113	109
Oceania	121	130	93
Asia-Far East.....	115	125	91
1960			
Near East.....	177	157	113
North America.....	171	141	121
Latin America.....	161	171	94
Africa	153	153	100
Western Europe.....	150	127	118
Oceania.....	146	164	89
Asia-Far East.....	141	149	95

Finally, most of the changes in pattern have been set before 1950, although Western Europe and Asia gained relatively in the decade of the fifties, and Africa lost. This can be attributed to effects of the war and a return to "normal."

If one arranges the regions in order of per capita income or of industrialization, or of export-import balance, *no noticeable correlation* appear to exist.

An effort to study these trends somewhat more closely has been made along three lines—(a) a comparison between 45 countries where FAO has readymade data; (b) a comparison of aggregate production by continents for major crops; (c) a comparison by continent of yield per acre for major crops.

A Comparison of Growth of Food Production by Country

In table A, a few basic data are given, taken from the FAO statistical yearbooks. Unfortunately, the 45 countries which are listed are unevenly distributed. For instance, in Africa, south of the Sahara, only the Union of South Africa has readily available data. Yet, the sample seems of sufficient size to make a comparison. From the data available, I have divided the countries as fast, slow, and moderately growing in food production. I took fast to mean over 50 percent in the period 1934-38 to 1957-60 or 1959, whichever was the highest. For the purpose of the following table I have not followed the broad additional continental or "regional" data, but departed somewhat.

North America, Australia, South Africa-----	<i>Fast</i> 3	<i>Medium</i> 2	<i>Slow</i> —	<i>Total</i> 5
Europe, excluding Mediterranean-----	1	4	7	12
Latin America-----	5	1	2	8
Mediterranean-----	5	2	3	10
Asia-----	3	3	4	10
Total-----	17	12	16	45

This analysis again does not show a direct relation between geographic location or level of economic development and the speed of agricultural expansion. True, none of the Anglo-Saxon, modern, large-size-farm countries moved slowly, and hardly any European non-Mediterranean country moved fast. (The Netherlands and Denmark come closest.) In contrast, the number of "fast moving" countries in Latin America and along the Mediterranean is large. If we tabulate the same countries on the basis of per capita food production, the picture changes dramatically. This is done below.

Here we mark per capita production between 105 and 95 percent of 1934-38 as stable; above and below these benchmarks, as improvement and decline.

	<i>Improve- ment</i>	<i>Stable</i>	<i>Decline</i>	<i>Total</i>
North America, Australia, South Africa-----	2	1	2	5
Europe, excluding Mediterranean-----	8	3	1	12
Latin America-----	4	1	3	8
Mediterranean-----	5	4	1	10
Asia-----	2	1	7	10
Total-----	21	10	14	45

In this table, Europe shows a remarkable improvement, and the Mediterranean countries come out well, also. However, a majority of Asian countries shows declining production per capita. The Western Hemisphere and the Dominions in the Southern Hemisphere show a more even spread of improvement and decline.

Would a further more detailed look at the available data give us more clues?

In table A, an attempt has been made to group the countries into five groups, taking into account both increase in total production and in population; hence, also, in per capita production.

The first group is characterized by seriously lagging production. The decrease in per capita production is 15 percent or more. Political difficulties, including World War II damage, appear to link these countries together.

The second group largely has "stable" production per capita under conditions of a relatively slow increase both in population and in production. To this group belong five European countries with a difficult environment, one country (Western Germany) with profound structural changes. More important, to this group belong the three most populous countries in south and

southeast Asia. Here, the main difficulty is how to organize over a hundred million illiterate peasants into higher productivity. It is one of the hard-core problems of our times.

The third group shows a decline in per capita production, but largely on account of a rapid increase in population. In the case of Australia and New Zealand, marketing problems pose a handicap. In the discussion between the United Kingdom and the Common Market, these two countries are in the most vulnerable position.

We then come to two groups of countries where production per capita at least kept pace with population increase. In countries with a low or moderate increase in population we find the majority of European countries and—in a position of transition to the countries with fast-growing population—very close together Japan and the United States of America.

Finally, the last group shows a rapid to ultra-rapid increase in population, but an even more rapidly expanding agriculture. Some of these countries export an appreciable part of their production, but some are, even at present, net food importers.

It is difficult to draw general conclusions from these data. The countries that did best appear to belong to three groups: (a) The majority of European countries with a growth-promoting agricultural policy; (b) the United States and Canada; and (c) furthermore, a group of countries in the intermediate stage of economic development—expanding in most instances in population, agriculture as well as industry. The Eastern Mediterranean, some countries in subtropical Latin America and Japan belong to that group. Difficulties in competing on export markets, in some cases combined with slowly developing and small domestic markets, seem to lead to a "sluggish" agriculture. Finally, a number of countries, mostly in Asia and South America, could not keep pace.

Food Production Trends by Type of Crops

The aggregates of food production by region and country, of course, have been calculated on the basis of the production for each crop and type of domestic animal.

Again, in this short review one can only look at a few main crops for which FAO gives data for 1934-38 and subsequent years. Although FAO not always includes specific figures for the U.S.S.R. and mainland China in crop-production figures, it proved feasible to deduce these data from estimated world totals. With some reservations, therefore, table B also includes data on these two countries. However, world totals excluding them have also been given.

Table B assembles data for aggregate production and (upon conversion by the factor of population increase) per capita production in 1959-60 as compared to 1934-38. The products selected in

this study are cereals, the main root crops combined, meat, milk, and sugar.

Among the cereals, *wheat* made progress, on a per capita comparison, mainly in the Temperate Zone of the Northern Hemisphere—in Russia, Europe, North America, and even Asia. It lost heavily in South America; some in Africa; more in China. In balance, it gained some 11 percent in per capita production. *Rye* and *oats* have lost ground wherever grown (on the cool and wet side of the wheat area). The reasons most likely are less striking improvements in productivity per acre, shifts in consumption to wheat, and replacement of horses by tractors.

Barley decreased where it is used for direct human consumption; it gained for fodder and, most likely, also for brewing purposes. On balance, it gained more than wheat.

Maize moved fastest ahead of all cereals, with the exception of South America and Oceania. Hybrid corn will undoubtedly strengthen this trend in years to come.

*Millet*s and *sorghum*s are definitely on the decline as food for low-income groups, but became in a sense a completely new crop in the United States.

Rice made a spectacular spurt in the Western Hemisphere and Africa. It also is reported to have gained very rapidly in China, but production has barely kept up with population in the rest of Asia. This last fact again signals a danger point in food production.

Taking *all cereals together* (on a tonnage basis without conversion, which has its acknowledged limitation), it turns out that cereal production in the world, outside of the U.S.S.R. and mainland China, rose by a meager 5 percent. Worse, South America, Africa, and Asia show a decline. A word of caution must be added: In North America and Europe, a large part of cereal production is used for fodder rather than for food and these data therefore do not indicate availability for food.

The production of *root crops* (potatoes, cassava, sweetpotatoes, and yams taken together) declined heavily—on a per capita basis—in Europe and North America. Shifts in consumer preference are the main reason. In South America and Asia, increased root-crop consumption had to supplement lagging cereal production—not a happy sign. In Africa, statistical data seem to indicate that root crops, in relation to population, went down. Mainland China reported a tremendous increase in the production of sweetpotatoes—the lifesaver in many hungry Asian lands.

The data on *animal products* are statistically among the more difficult ones to assemble. It may surprise that world *meat* production went up very rapidly in Europe, the U.S.S.R., Asia, and Oceania. The areas where meat production could not keep pace with population are South America (beef), and mainland China (pig population). Per capita meat consumption rose appreciably as

the world average. The data for *milk*, on the other hand, are disquieting. The only areas where per capita milk consumption did rise are Europe and the U.S.S.R. Elsewhere, per capita production decreased, and for the world as a whole it is the one major essential food which could not keep pace.

Milk Needs More Attention

It appears much more difficult, in the hot and the dry zones, to produce milk than meat of some kind. *Production trends for milk should have closest attention in all development programs and programs for aid in food.*

In contrast, *sugar* production rose very fast in all continents with the exception of Australia and southeast Asia. Sugar became more plentiful because both in cane and in beet agricultural and technological progress has been very fast over the last quarter of a century.

We have already mentioned some of the apparent reasons for shifts between crops. The main one is change in food habits on the basis of economic development or distress. Corn, sorghum, and barley facilitated an increase in meat production. Improved grassland or other fodder has not yet turned the tide for the dairy cow. Differentials in economic growth and in technology, therefore, both seem to have played a major role.

Insofar as the data are reliable, Africa seems to have lost most on locally produced food stuffs. The data for the U.S.S.R. on balance show a slow increase in total cereal production, except for the showpieces, wheat and maize. The data for China, on the other hand, are astonishing. However, the years 1934–38 already were badly affected by internal strife and the war with Japan. In the U.S.S.R. improvement in meat, milk, and sugar—undoubtedly from a low level in 1934–38—has been very great. In all comparisons of U.S.S.R. data one must keep in mind the terrific war losses, both in production capacity and in population. In the period under consideration, the net increase in population remained even below the rest of Europe. For the world as a whole, outside of the U.S.S.R. and mainland China, there is a precarious balance between cereals and root crops. There is some more meat, but somewhat less milk. However, considerably more sugar is being produced than in 1934–38.

Acreage and Yield

Shifts in the production of specific crops are the results of new land (or intensified cropping patterns), shifts between crops, and changes in yield per acre.

The general trend is a combination of both increasing acreages and higher yields. One of the intriguing questions with regard to future food production is this relationship between acreage and yield.

There is no opportunity at this occasion to consider individual countries in this respect. In table C, some data from FAO production year-books have been set together. From these data it appears that North America has made the fastest progress in yields. Among the cereals, maize and sorghum have moved faster than others. Soybeans and cotton also are crops where research and extension have had a spectacular success. These four crops, taken together, have revolutionized American agriculture in the last 30 years.

Table C offers, in a summary form, an indication of progress and tasks undone, expressed as yield per acre.

Europe still produces on the average more wheat, barley, and rice per hectare than any other continent. But in maize and sorghum and potatoes, North America has taken first place. In cotton—thanks to the very generous application of chemical fertilizer, the U.S.S.R. shows highest yields. South America, except for a small area of potatoes, shows hardly any change in yields. The same applies to Asia and Africa. In Australia, sorghum and maize show the influence of achievements in North America.

Scars of World War II Still Show

In Europe, the U.S.S.R., and Asia, average production in 1948–52 still showed the scars of World War II, and the rate of improvement over the last decade is somewhat better than the average.

Summarizing, whereas in 1934–38 Europe stood out as highly producing per hectare, this continent has now been joined by North America. This had important effects upon world food production trends.

In the short time available, I only want to present a *summary of acreage and yield for all cereals together*, thus also lumping together any replacement of less productive grains by more highly yielding maize and rice.

For that purpose, the world picture can be reduced to a nutshell in a comparison of three major areas:

- (a) Europe, North America, and Oceania.
- (b) Soviet Russia, and mainland China.
- (c) Asia, Africa, and South America.

Taking 1934–38 as a base, world cereal-production trends can be summarized as follows (indices, 1934–38=100):

	Europe, North America, Oceania	U.S.S.R. and China	Asia, Africa, South America	World
Acreage:				
1948–52-----	98	109	110	106
1959–60-----	99	126	125	116
Yield per acre:				
1948–52-----	123	124	96	99
1959–60-----	157	123	111	129
Tonnage:				
1948–52-----	121	134	103	136
1959–60-----	156	156	136	150

When we compare these major regions of the world, we find that the industrialized free world

made by far the best progress in yield per acre, especially during the last decade. As in the “West” the acreage under cereals remained constant, tonnage increased just as fast as was the case in the U.S.S.R. and China combined. In this part of the world, increase in production was reached in the same proportion by increase in acreage and increase in yield. In both these areas, as we have seen before, production of cereals increased well above population, allowing for more conversion of cereals into animal products and more exports. The position of “Asia, Africa, and Latin America” is quite the contrary. Although acreage under cereals increased by 25 percent, exactly as much as was the case in the U.S.S.R. and China, yield per acre rose by only 11 percent. If one takes into account that Egypt, Japan, Taiwan, and South Africa are included, the remainder of these continents will show very little improvement, indeed.

We then find ourselves confronted with the situation in three continents, where cereals production increased by 36 percent and population by 41 percent. Changes in the pattern in world trade in cereals had to make up for the deficit.

In fact, this is what happened. In 1934–38, the three continents under consideration had net cereal exports to other parts of the world of 11 million tons. In 1960, they imported from other continents 16 million tons of grain. For recent years, their balance in cereal production has deteriorated by about 1 million tons a year.

In absolute terms, production of cereals increased from 200 to 270 million tons. Consumption rose from 189 to 287 million tons, an increase of 52 percent. Under the impact of economic development, consumption rose by 6 percent per capita over a period of 23 years. If it had not been for an increase of exports of cereals from North America from 7 to 32 million tons, balancing the shortage in the low-income countries, there would be even more malnutrition and hunger. I cannot foresee how long this increasing imbalance can and will go, nor whether a new equilibrium can be found.

Higher Production Mandatory

But it seems obvious that in the “*decade of development*” the most pressing challenge is to raise the level of productivity per acre in the developing countries. The nonindustrialized world is seriously lagging in food production not by lack of effort to increase the area of cropland, but by low and stagnant yields. What is true in crops, undoubtedly even more so, is the case in animal husbandry.

As has been said before in this conference, this means a change in rural institutions, administration and management of development schemes. It will mean, first of all, research, training, and extension services, equipping the peasant in these

areas with the skill, the means, and the incentive to grow more food.

At the beginning of the second century of the United States, it is good to remember the achieve-

ments of the past. But it is necessary to remind ourselves that only in a truly international and joint effort it will be possible to achieve the world-wide challenge of the present.

TABLE A.—*Food production trends in selected countries*

Country	Index of popula- tion, 1959-1937	Index of production		Produc- tion per capita recent/ prewar	Note
		1948-52/ 1937	1959 (1957-60)/ 1934-38		
I. Production lagging seriously, decrease per capita 15 percent or more (in the order of deficiency in production)					
Argentina.....	153	92	98	64	Absolute decline.
Taiwan.....	186	117	141	76	Immigration.
Burma.....	131	89	101	77	War damage, civil unrest.
Algeria.....	149	104	115	77	Civil unrest.
Uruguay.....	135	125	105	78	Almost position of Argentina.
South Korea.....	157	94	127	81	War damage.
Malaya.....	164	104	140	85	Civil unrest.
(Laos, South Vietnam most likely in similar position)					
II. Both population and production show low to medium increase, production lags up to 10 percent or barely keeps up with population (in the order of population increase)					
Spain.....	119	101	118	99	Difficult environment.
Sweden.....	120	114	109	91	Do.
Portugal.....	122	112	127	104	Do.
Norway.....	122	114	118	97	Do.
Switzerland.....	126	118	128	102	Do.
Western Germany.....	131	113	128	98	Immigration, industrialization.
Pakistan.....	132	112	124	94	Difficult to organize.
Indonesia.....	134	99	125	93	Do.
India.....	134	109	132	99	Do.
III. Rapid increase in population, production lagging up to 10 percent (in the order of population increase)					
Australia.....	147	116	132	91	Marketing problems.
New Zealand.....	147	119	138	94	Do.
Chile.....	154	127	139	90	Inflation.
Morocco.....	146	131	145	98	Difficult environment.
Tunisia.....	154	125	149	96	Do.
Ceylon.....	168	138	156	93	Population explosion.
IV. Low or medium increase in population, production forging ahead (in the order of population increase)					
Republic of Ireland.....	96	103	107	112	
Austria.....	105	100	126	120	
Belgium/Luxembourg.....	109	124	146	134	
France.....	110	108	129	118	
United Kingdom.....	111	127	143	129	
Italy.....	115	119	155	135	
Greece.....	116	111	174	150	
Yugoslavia.....	118	73	177	154	
Denmark.....	121	129	150	124	
Finland.....	123	128	147	119	
Netherlands.....	132	130	151	115	
Japan.....	132	120	156	118	
United States.....	137	146	169	124	

TABLE A.—*Food production trends in selected countries—Continued*

Country	Index of population, 1959-1937	Index of production		Production per capita recent/prewar	Note
		1948-52/ 1937	1959 (1957-60)/ 1934-38		
V. Rapid increase in population, production keeps pace (in the order of population increase)					
U.A.R. (Egypt)-----	146	122	166	114	
Union of South Africa-----	150	140	173	116	
Cuba-----	152	143	164	108	
Canada-----	154	179	158	103	
Peru-----	157	143	171	109	
Thailand-----	162	142	173	107	
Colombia-----	162	170	192	117	
Brazil-----	167	127	172	103	
Turkey-----	169	168	190	113	
Mexico-----	180	153	236	132	

Source: FAO statistical yearbooks on production.

TABLE B.—*Production in 1959-60 in percent of 1934-38*

Product	Europe excluding U.S.S.R.	North and Central America	South America	Asia excluding China	Africa	Oceania	U.S.S.R.	Mainland China	World	World, excluding U.S.S.R. and mainland China
Wheat.....	132	160	101	148	134	130	181	127	150	150
Rye.....	100						66		83	103
Oats and mixed grains.....	84	116					68		93	103
Barley.....	180	225	213	130	97	400	100	210	162	170
Maize.....	148	213	90	152	176	100	270	365	191	174
Millet/sorghum.....		1,070		114	136		45	95	130	165
Rice (paddy).....	146	275	333	136	209			247	170	134
All cereals.....	148	193	119	136	146	153	121	190	150	141
Main root crops.....	98	104	240	190	124		118	480	146	124
Meat.....	170	170	128	177	147	157	233	143	155	148
Milk.....	122	122	157	123	126	117	154		128	124
Sugar.....	159	212	273	143	237	89	282	540	190	177
Population increase.....	113	145	162	137	150	127	111	151	136	134

Production per capita in 1959-60 in percent of 1934-38

Wheat.....	117	111	63	108	89	102	164	84	111	112
Rye.....	88						60		61	77
Oats and mixed grains.....	74	80					61		68	77
Barley.....	159	155	132	95	65	300	90	139	119	127
Maize.....	131	147	56	111	118	79	243	241	141	130
Millet/sorghum.....		710		83	91		41	63	96	123
Rice (paddy).....	129	190	206	99	140			164	125	111
All cereals.....	131	133	74	99	97	121	109	126	110	105
Main root crops.....	87	72	149	139	83		107	317	108	93
Meat.....	150	117	79	129	98	124	210	94	114	110
Milk.....	107	84	97	90	84	93	139		94	92
Sugar.....	141	146	168	104	158	70	254	357	140	132

Source: FAO statistical yearbooks on production.

TABLE C.—*Food production trends in selected countries*

Average yields in quintals per hectare*

Product	Europe			North & Central America			South America		
	1934-38	1948-52	1959-60	1934-52	1948-52	1959-60	1934-38	1948-52	1959-60
Wheat.....	14.2	14.7	18.3	8.2	11.6	13.6	9.6	10.8	11.6
Barley.....	15.4	16.9	23.0	11.1	14.3	14.7	9.4	11.3	12.0
Maize.....	14.8	12.4	22.1	13.3	22.1	27.7	15.3	12.4	13.3
Millet/sorghum.....	9.3	8.4	11.7	8.1	12.5	22.8	8.2	7.8	11.2
Rice (paddy).....	57.8	42.2	44.0	21.9	22.1	27.4	15.3	17.1	17.9
Potatoes.....	135.0	138.0	145.0	78.0	147.0	175.0	44.0	53.0	63.0
Sweetpotatoes.....	160.0	147.0	127.0	45.0	45.0	49.0	75.0	78.0	90.0
Cotton.....	2.1	1.5	3.1	2.4	3.2	5.2	2.0	1.8	2.0

Product	U.S.S.R.			Oceania		
	1934-38	1948-52	1959-60	1934-38	1948-52	1959-60
Wheat.....	9.3	8.4	11.0	11.3	11.3	11.6
Barley.....	9.6	7.4	10.5	9.9	12.1	8.2
Maize.....	10.7	13.7	13.8	15.0	17.5	23.8
Millet/sorghum.....	(¹)	3.1	4.8	3.2	12.8	17.9
Rice (patty).....	21.5	14.5	22.1	38.0	32.0	43.0
Potatoes.....	86.0	104.0	91.0	77.0	97.0	125.0
Sweetpotatoes.....	(¹)	(¹)	(¹)	(²)	110.0	100.0
Cotton.....	3.3	4.3	7.0	(¹)	(¹)	(¹)

Product	Asia except China			Africa		
	1934-38	1948-52	1959-60	1934-38	1948-52	1959-60
Wheat.....	8.5	8.2	8.9	6.9	7.1	7.1
Barley.....	10.4	10.1	10.4	6.3	6.5	5.4
Maize.....	9.1	7.8	9.5	8.1	8.1	9.4
Millet/sorghum.....	5.0	3.8	4.5	(²)	5.9	7.7
Rice (patty).....	15.2	13.9	16.5	11.9	12.2	15.2
Potatoes.....	85.0	81.0	91.0	55.0	59.0	85.0
Sweetpotatoes.....	77.0	94.0	103.0	62.0	69.0	71.0
Cotton.....	1.2	1.4	1.4	1.2	2.1	2.4

¹ No production. ² Data missing.

*Source FAO statistical yearbooks on agricultural production.

The World Food Budget: A Forward Look to 2000 and Beyond ¹

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IN OCTOBER 1961, the U.S. Department of Agriculture released a publication entitled "The World Food Budget—1962 and 1966." This study dealt with world food needs and availabilities as they existed in 1958, with projections to 1962 and 1966.

¹ This paper is based in part upon past research work in the Economic Research Service, USDA. Grover Chappell and Arthur Mackie of the USDA were particularly helpful in preparing this paper.

And this is what we mean by the term "food budget": the balancing of food needs against food supplies, where productive resources are scarce and needs are varied and great.

In thinking about world food budget problems, we could look backward into the past century and gain a perspective on the long-run balance between man's dietary needs and his ability to produce food to meet those needs. A good historical

analysis should shed much light on the problem. But we shall not do that in this paper. Today, I want to explore the balance between food requirements and food production in the context of potential world economic development up to the year 2000.

There are some important interrelations between the food balance and potential economic development that need testing for internal consistency and plausibility. What will the world food balance look like with different rates of economic development? And what rates of economic development can be achieved given prospective food requirements and production possibilities? These are the kinds of questions that I will explore in this paper for the long-run period 1960–2000.

Perhaps the two most important variables in the construction of a world food budget are population trends and world food production trends. Here I will draw upon the ideas of Dr. Notestein and Dr. deVries as they have presented these two subjects earlier this morning. Currently one-third of the people of the world have progressed beyond the stage of a minimum nutritional diet. Most of these people are choosing freely the kinds of food and nonfood items that they want in the marketplace. But the majority of the world's people—some two-thirds—are, we hope, in a period of transition from a situation wherein their diets are nutritionally inadequate to a situation where they too can choose from a relatively bountiful supply of food and other products. When we reach this millennium, *and particularly while we are on our way to it*, two additional variables will help determine the nature of the balance in the food budget.

These variables are per capita real income and consumer preferences for food versus nonfood products and services. In projecting a world food budget, I will try to work with expected improvements in real income and with measures of the income elasticity of food that are reasonable and realistic. What we assume with respect to these variables will have an important bearing on the economic development process itself.

Let me call your attention now to a difficult problem with which we will struggle during much of this paper. The income elasticity of demand for food in underdeveloped countries is high. It approaches 1.0 in some situations.² This high-income elasticity of demand for food means that, in the absence of food rationing or extremely high imports of food from the developed world, food production in the underdeveloped countries must increase virtually at the same rate as the total production of goods and services. And a problem arises because food production has shown a tendency to increase rather slowly in the developing nations (and perversely,

² With an elasticity of 1.0, a 10-percent increase in income results in a 10-percent increase in expenditure for food.

quite rapidly in the developed countries). This means that agricultural production could be the major limiting factor in the economic development of transitional economies. This will lead me into some highly tenuous, but I hope constructive, comments upon the interactions between the development of agriculture and other segments of a growing economy.

The Situation Today

The USDA's World Food Budget

Let us first look at the world food budget as of 1962. *We find that the world food budget is not in balance.* It would require the additional consumption of 1.1 billion bushels of wheat, of 7.0 billion pounds of vegetable oils, of 3.5 million bags of dry edible beans, and of 3.3 billion pounds of nonfat dry milk to correct the imbalance. And our projection for the short-run period 1962–66 indicates little change in this food deficit picture.

Now a brief word as to how we arrived at such a deficit. Available supplies, including local production and imports (both commercial and food aid), present no conceptual, but many statistical, difficulties. Requirements for those people who live in the 30 developed countries that have no appreciable nutritional problems were estimated on the basis of what was, or would be, demanded in the marketplace. On the other hand, the requirements for those 2 billion people who live in 70 underdeveloped countries were calculated on the basis of a minimum nutritional standard. This nutritional standard together with a comparison between a particular underdeveloped country, Indonesia, and with the United States as of 1958 is as follows:

[Grams per person per day]

	Nutritional standard	1958 consumption	
		Indonesia	United States
Animal protein.....	7	4	66
Animal plus pulse protein.....	17	14	71
Total protein.....	60	48	97
Fat.....	38–45	38	149
Total calories.....	2, 300–2, 700	2, 125	3, 220

The shortage in supply of animal protein relative to the minimum nutritional standard was expressed in the World Food Budget study in terms of the quantity of nonfat dry milk required to fill this nutritional deficit. The remaining shortage in other high-quality proteins was expressed in terms of dry edible beans and peas. The shortage of fats was expressed in terms of vegetable oil. It was then determined that the remaining shortage of both nonspecialized proteins and total

calories could be met by the consumption of 1.1 billion bushels of wheat.

A Short-Term Projection of the World Food Budget: 1958-66

Let us take a quick look at the overall food balance and some of the variables involved as they were developed in the USDA Food Budget for the year 1966. The World Food Budget shows projections of population and production, consumption and resulting deficits or surpluses for particular foods for developed and underdeveloped countries.

In this study, population was estimated to increase at an annual growth rate of 1.9 percent for food-deficit countries, compared with 1.25 percent for developed nations. The production of the major food items such as wheat, rice, and coarse grains in the underdeveloped countries was projected to increase at about 1.5 percent per year. Vegetable oil was the only major food item where output was projected to increase faster than population in these countries. The per capita consumption of basic foodstuffs in the underdeveloped countries was estimated to increase slightly as the result of large imports from food surplus regions. But, as stated previously, the absolute level of the aggregate food deficit for these countries was estimated to hold about constant from 1962 to 1966.

The above projections were based in the main upon established trends in production and consumption. Due to the short time period involved, those projections did not explicitly take into account the growth in real per capita income and the expected income elasticities of food. For the same reason, no basic structural changes in agricultural production were assumed. For the longer period of time that we are considering today, we will attempt to deal explicitly with income changes, changes in elasticity, and structural changes in production.

The World Demand for Food, Assuming Rapid Economic Development

Countries That Are Presently Developed

As of 1960, the basic determinants of the demand for food in developed countries are these: a population of some 1 billion people with an available income of \$900 per year per person, and an expenditure allocation for food that takes only about 10 percent of each person's income measured on a farm price basis. But for these countries, the income elasticity of demand for food is low and may even approach 0.10. This means that food consumption *per person* increases only slightly with rising real incomes. This can result in a problem very different from the one of deficits referred to earlier with respect to the underdeveloped countries; it is a problem of food supplies outracing commercial demand—a prob-

lem that has become most familiar in the United States, and I suspect from what I observe in Western Europe, that it is a problem that may encompass all developed nations.

On the production side, food supplies in these nations are plentiful and can be readily increased to meet any expected additional demand; we estimate, for example, that crop production could easily be increased by 25 percent in the United States by 1967. Food production can thus be projected at a level commensurate with expanding demand in the developed countries, plus whatever may be exported commercially and as food aid to the underdeveloped countries of the world.

Now let us consider the important variables that will determine the food budget for developed countries in the years 1980 and 2000. (See table 1.) First, we project population to increase at an annual rate of about 1 percent per year, which is consistent with the high population projections made by the United Nations. This growth rate would result in a total population in these 30 countries of about 1.5 billion in the year 2000, compared with 1 billion in 1960. This estimate is not too different from the projections made earlier this morning by Dr. Notestein.

Real income per capita is projected to increase from \$900 in 1960 to almost \$2,000 by the year 2000, or an annual growth rate in per capita income of 2 percent per year. While this is slightly higher than the rate recently observed for the United States, it is somewhat less than the current experience of most of the other developed countries.³ This per capita rate results in a growth in *total income* of about 3 percent per year for the developed world. Thus, in this model for the developed world, *total purchasing power* more than triples over the 40-year period.

Next, we project an income elasticity of demand for food at the farm level of 0.20 for the period 1960 to 1980, and 0.15 from 1980 to 2000. While there is evidence to indicate that the income elasticity for food in the United States is close to 0.10, in most other developed countries where income is somewhat lower, this elasticity is estimated presently to be about 0.35.⁴ However, by the year 2000, most of these countries will have per capita incomes about equal to that of the United States today.

In applying these income elasticities to the assumed growth in real income per person, we find that per capita food consumption will increase only about four-tenths of 1 percent per year up to 1980, and one-fourth of 1 percent thereafter. Food expenditures per person which stood at \$79 (farm value) in 1960 would increase to \$85 by 1980 and to \$90 by the year 2000. *Total food con-*

³ United Nations, FAO. *Agricultural Commodities—Projections for 1970*. FAO Commodity Review, 1962, Rome, table 1, p. iii. The average growth rate of GNP per capita was reported at 3 percent per year for 1950-59 for high-income countries.

⁴ *Ibid.*, p. A-14.

sumption in these countries would increase a little less than 1½ percent per year, or less than one-half the rate of growth in total national income.

As stated above, food production in developed countries should be realistically projected at a rate equal to the growth in domestic demand, plus whatever can be exported as commercial trade and as food aid to underdeveloped nations. It is interesting and instructive, however, to examine the balance between food demand and food production if food output were allowed to increase in accordance with its technological potential. In the World Food Budget published by the USDA, it may be observed that agricultural production in developed countries increased at an annual rate of 3.1 percent per year during the period 1953 to 1960. This is more than double the rate of increase in the demand for food that can be expected over the next four decades.

Thus, the model in table 1 generates an imbalance in the food budget in the form of a food surplus for developed countries by the year 2000 equal to \$126 billion. In other words, potential food supplies in the developed countries would exceed requirements in these countries by the year 2000 by a quantity equal to \$126 billion. This tendency toward a surplus imbalance is so large that it would undoubtedly put a heavy price and income pressure upon agricultural producers to shift productive resources into nonfarm pursuits as a means of correcting the imbalance. But it does suggest for the years ahead that supply management must play an important role in the agriculture of virtually all industrialized countries—if producers in those countries are to escape very great price and income disparities.

It is also interesting to calculate the rate of growth in real income per person in the developed countries that would be necessary to absorb the full agricultural output potential. Here we will assume again that food output will increase 3 percent per year, but about \$10 billion worth of food would be exported in 1980 to underdeveloped countries, partly as food aid. (And parenthetically, the transfer of food products to the underdeveloped world in the amount of \$10 billion on a net basis represents a tremendous trade development.) Even so,—with the low-income elasticities that are expected to prevail, income would need to increase to about \$13,000 *per person* in the developed countries by 1980 to create an effective demand for this potential food supply. It is also interesting to compare potential food production with the expected demand in the developed countries in the year 2000 from the standpoint of the indicated degree of resource adjustment and/or supply control that might be necessary at that time. Potential production in the year 2000 is almost double expected demand. Clearly the food budget will not be easy to balance in the developed countries during the next 40 years.

Countries That Are Presently Underdeveloped

The key variables in a world food budget for the years 1980 and 2000 are dominated by possible changes in those countries that are presently underdeveloped. In these countries, population may increase very rapidly over the next 30 years. Real income per capita could increase slowly, but we hope that it will soon begin to increase at a rate faster than in developed countries. Uncertainty with respect to the above two variables, in combination with an elasticity for demand for food which approaches 1.0, means that the demand for food could increase moderately, or it could soar to unexpected heights. It is for these analytical reasons, even more than the fact that these countries contain two-thirds of the world population, that I concentrate our attention on the underdeveloped world.

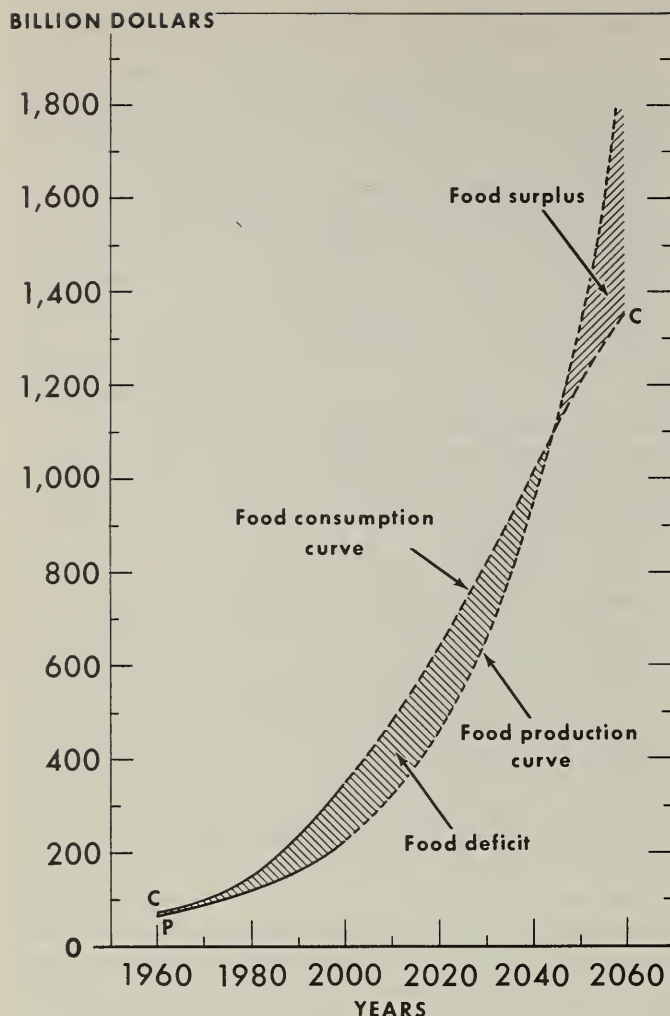
Many underdeveloped countries are presently experiencing a sustained high birth rate at a time when death rates are falling sharply. Declining death rates are due in part to increases in economic well-being, but are thus far influenced mainly by the importation of medical and sanitary techniques from developed countries. Thus, population is tending to increase rapidly in what some population experts call Stage II, or the early expanding stage, of the population cycle.⁵

If we assume rapid economic development in these countries, death rates will continue to decline and eventually birth rates may begin to fall also. In this stage of the population cycle (Stage III), total population continues to grow rapidly. In terms of the time periods that these two population stages have taken in countries that are now developed, total population in the underdeveloped countries can be expected to continue to expand rapidly over the first half of the next 100 years. Some time in the second half of this 100-year period, both death rates and birth rates should stabilize at a low level, and population growth slow down as is now the case in the developed countries. Of course, the vigorous pursuit of birth control education and other population policies in the underdeveloped countries could shorten these population stages significantly.

Under the assumption of rapid economic development, real per capita income also will increase rather rapidly over the next 40 to 60 years. However, incomes per person will still be low relative to incomes in the developed countries, and the income elasticity of demand for food will remain relatively high.

Under these assumptions, the demand for food in the underdeveloped world would increase dramatically over the next several decades, and then gradually slow down as population growth declines and income elasticities drop at the higher levels of income. This situation may be portrayed

⁵ *World Population and Resources*, a report by PEP (Political and Economic Planning), September 1955.



Underdeveloped Countries: Food Consumption and Production Projections, Assuming Rapid Economic Development and Population Growth.

by the food consumption curve CC in figure 1. The growth curve CC increases at an increasing rate over the period 1960–2000 as the result of: (1) rapid population growth and (2) rapid economic development that gives rise to sustained increases in real per capita income. But the rate of growth in the demand for food, as represented by curve CC in figure 1, slows down between 2000 and 2020 as the result of a decline in the rate of population growth in conjunction with a declining income elasticity for food.

On the supply side, I postulate a rate of growth in food output per person in the underdeveloped world that is rapid by past experience, but not fast enough to meet the increased demand consistent with rapid economic growth and a high-income elasticity for food. Thus, a food-deficit gap opens up over the long period 1960–2040. It will be recognized, of course, that the consumption-production developments portrayed in figure 1 cannot obtain in practice, unless the deficit is somehow met; if it is not met, the rate of economic development implicit in the consumption curve

cannot be realized; hence the rate of growth in the demand for food will slow down. The food supplies must be there if rapid economic development is to be sustained.

Now let us look more carefully at a complete model for the underdeveloped world for 1980 and 2000. (See table 2.) We assume that population in the underdeveloped countries will increase at a rate equal to the United Nations "high" rate. This rate is 2.2 percent per year up to 1980, and 2.8 percent to the year 2000. Let us further assume that per capita real income will increase 2.5 percent per year; this is considerably higher than the rate of 2.0 projected for the developed countries. The income elasticity of demand for food is estimated to average 0.70 through 1980, and 0.60 from 1980 to 2000.

These population and income factors would increase the total demand for food in the underdeveloped countries 4 percent per annum between 1960 and 1980—and increase total food consumption to \$146 billion by 1980. If we assume that food production would increase only 3 percent per year in these countries—which is the highest rate previously observed for this aggregation of countries⁶—we find that total food output would reach only \$119 billion by 1980. Under these conditions the underdeveloped world would experience a potential food deficit of \$27 billion. By the year 2000, this deficit increases to the startling figure of \$114 billion. Such a deficit is, of course, much larger than any quantity that could be made available from developed countries through economic aid. It also overshadows any reasonable expectation of foreign exchange availabilities for commercial imports of food—or any conceivable combination of the two. Thus, this model too is not internally consistent; the rates of economic development, food consumption, and food production projected could not be realized in practice; something must give somewhere.

Very shortly, I will try to point out *why* the tendency for food production to lag behind the desired growth in real income will effectively limit the rate of general economic development. For the moment, however, let us *assume* that per capita income will not increase faster than is necessary to bring about a balance between the demand for food and food availability. But in this case, let us allow for net imports of food from the developed countries at a level of \$5 billion in 1980, and \$10 billion in the year 2000 compared with approximately \$1 billion in 1960. Here, employing the concept of income elasticity of demand, we find that the low rate of growth in real income of 1.3 percent per person per year from 1960 to 1980 and seven-tenths of 1 percent per year for the period 1980 to 2000 would balance food demand with available supplies. This is a gloomy picture of economic development. It is

⁶ *The World Food Budget, 1962 and 1966*, ERS, USDA, October 1961.

well below people's income expectations in these developing countries, and hence is ominous from the standpoint of political stability in the free world.

The World Demand for Food, Assuming Only Moderate Economic Development

The Role of Agriculture in Economic Development—a Necessary Digression

Agriculture must play an important role in the economic growth of underdeveloped countries—if for no other reason—because of its huge size relative to the nonagricultural sector. In many of these countries, 60 to 80 percent of the population is engaged in agricultural pursuits, with as much as half of the gross national product being derived directly from agriculture. Agricultural products also loom large in the trade balance of these countries both as exports and imports. In this connection, if food output could be expanded relative to effective demand, this would make more food available for export, or reduce the necessity for food imports. In either case, foreign exchange would become available for the importation of capital goods that are essential to economic growth. But with the high-income elasticity that exists, the effective demand for food expands almost proportionately with total income. Thus to increase food output relative to demand means that food production must increase faster than nonfood output. And this probably would not look like “industrialization” to the leaders of many developing countries, although it could be an integral part of that development if they could bring it off.

Increased productivity in agriculture can also create purchasing power for the first products of an infant industry. These first crude products would perhaps readily meet the needs of the indigenous agricultural population. And such products would be less likely to compete favorably in distant world markets with products produced in the developed countries. Thus, a productive agriculture can serve as a much-needed nearby market for the products of a beginning industry.

Increasing productivity in agriculture would also result in an accumulation of financial resources in the agricultural sector that could become a source of capital for those men of imagination who are willing to take the first steps toward a modern industrial economy. And these capital resources could be used in part to produce the particular goods that a more productive agriculture would itself be demanding, such as fertilizers and better agricultural tools. Different societies have used different means of tapping the financial resources originating in agriculture for application to economic development. But care must be taken not to destroy the goose that “lays the golden eggs.”

In a primitive society, agriculture can contribute directly to capital formation in a number of ways. A sustained increase in output leading to a surplus of food and other agricultural raw materials over farm needs can serve as needed working capital. Food stocks, as a subsistence fund, are a primary form of capital that permits the development of roundabout production processes and hence more productive processes. And a healthy and vigorous labor force that is no longer needed in the agricultural sector to produce today's food requirements can with a few additional tools build roads, drainage ditches, dams, etc., and help provide the necessary overhead capital for a more modern economy. In many cases this work force can receive wages mostly in the form of food.

In sum, agriculture must provide the food and fiber surplus to first support the workers released from agriculture to nonfarm work; second, provide the increased food supplies demanded by nonfarm workers as development catches hold and their incomes increase, and at the same time provide financial capital and serve as the basic market. This is what is required of agriculture in the takeoff phase of development.⁷

In a negative vein, a low rate of growth in agriculture places a severe restraint on industrial development. During the early phases of development, the urban population will be increasing rapidly. If agriculture is not able to supply the additional food required by this growing population, then scarce foreign exchange would need to be diverted from capital items, such as steel and machinery, to imports of food. In terms of the projections in table 2, the tendency for real income to increase faster than food production is real, and likely to result in a severe inflation of food prices. If a balance is brought about in this fashion, food exports would fall and food imports would rise with the resulting adverse effects upon the foreign exchange position. It would also tend to reduce real wages in the industrial sector compared with that of the agricultural sector, and thereby slow down the movement of workers from agriculture to industry even where those workers are underemployed in agriculture. At the same time, capital that could otherwise be used in the industrial sector would tend to be diverted to, or remain in, agriculture where it would earn larger monetary returns—at least in the short run. In this way a balance would be achieved involving a slower rate of overall economic development, but a more rapid rate of growth in agriculture.

The imbalance in the demand for and supply of food has in some underdeveloped countries been controlled partially by food rationing. Rationing, however, would not prevent the slowdown in the

⁷ For an excellent discussion of the role of agriculture in economic development, see the paper *The Importance of an Agricultural Surplus in Underdeveloped Countries*, by William H. Nicholls, J. S. McLean Memorial Lecture, Ontario Agricultural College, January 1962.

TABLE 1.—*Developed countries—unrestricted food production with a large food surplus*

	Unit	Years			Annual rate of growth (percent, compounded)	
		1960	1980	2000	1960-80	1980-2000
Population ¹	Bil.....	1. 0	1. 19	1. 5	0. 9	1. 2
Income, per capita ²	Dol.....	900	1, 337	1, 987	2. 0	2. 0
Income, total.....	Bil. dol.....	900	1, 591	2, 980	2. 9	3. 2
Food consumption, per capita.....	Dol.....	79	85	90	. 4	. 25
Food consumption, total.....	Bil. dol.....	79	101	135	1. 25	1. 4
Food production, per capita.....	Dol.....	80	121	174	2. 1	1. 8
Food production, total (farm value) ³	Bil. dol.....	80	144	261	3. 0	3. 0
Food surplus.....	Bil. dol.....	1	43	126	-----	-----
Income elasticity of food ⁴	-----	0. 2	0. 15	-----	-----	-----

¹ U.N. high population estimates for 1980 and 2000.

² Annual growth rate of per capita income assumed at 2 percent.

³ Annual growth rate of food production assumed to continue as estimated in "World Food Budget 1962 and 1966," Foreign Agriculture Report No. 4, ERS, USDA, October 1961.

⁴ Income elasticity (Arc) assumed to decline with increased income.

TABLE 2.—*Underdeveloped countries—rapid economic development with an increasing food deficit*

	Unit	Years			Annual rate of growth percent, compounded	
		1960	1980	2000	1960-80	1980-2000
Population ¹	Bil.....	2. 0	3. 1	5. 4	2. 2	2. 8
Income, per capita ²	Dol.....	100	164	268	2. 5	2. 5
Income, total.....	Bil. dol.....	200	508	1, 450	4. 7	5. 4
Food consumption, per capita.....	Dol.....	34	47	63	1. 7	1. 5
Food consumption, total.....	Bil. dol.....	67	146	340	4. 0	4. 4
Food production, per capita.....	Dol.....	33	38	42	. 7	. 5
Food production, total (farm value) ³	Bil. dol.....	66	119	226	3. 0	3. 25
Food deficit.....	Bil. dol.....	1	27	114	-----	-----
Income elasticity of food ⁴	-----	. 7	. 6	-----	-----	-----

¹ U.N. high population estimates for 1980 and 2000.

² Annual growth rate of per capita income assumed at 2.5 percent.

³ Annual growth rate of food production assumed to increase slightly from that estimated in "World Food Budget, 1962 and 1966," Foreign Agriculture Report No. 4, ERS, USDA, October 1961.

⁴ Income elasticity (Arc) assumed to decline with increased income.

rate of movement of workers from the farm to the city. And, it usually results in inefficient food production, as food is produced on small plots outside of the scheme of control. It also results in much wasted effort on the part of consumers seeking to obtain rationed, or blackmarket, food. Except in time of a dire national emergency where moral suasion can be relied upon to enforce the rules of the rationing game, general economic growth is likely to be slowed by rationing as much as if food prices were allowed to rise to equilibrium levels.

I have given much attention here to the role of agriculture in economic development, particularly in the takeoff stage, because some countries are beginning to recognize that it will be difficult to achieve a rate of growth in agricultural output

consistent with their expectation for total economic development, but have not yet realized the full implication of these conflicting tendencies. Also, because most development theorists and planners have consistently underemphasized the key role of increased agricultural production in the early stages of overall economic development.

To the extent that the income elasticity of demand for food is less than 1.0 and to the extent that needed food supplies can be obtained from developed countries either as aid or as commercial imports, food production could increase more slowly than total output of goods and services. But the income elasticity of food is high and will continue high for many years to come. This puts a heavy pressure, a very heavy pressure, on rapid agricultural growth as an integral part of total

TABLE 3.—*Underdeveloped countries—a balanced food budget with moderate rates of food production and imports, and a low rate of economic development*

	Unit	Years			Annual rate of growth percent, compounded	
		1960	1980	2000	1960-80	1980-2000
Population ¹	Bil.....	2.0	3.1	5.4	2.2	2.8
Income, per capita ²	Dol.....	100	129	149	1.3	.7
Income, total ²	Bil. dol.....	200	400	805	3.5	3.6
Food consumption, per capita.....	Dol.....	34	40	44	.9	.5
Food consumption, total.....	Bil. dol.....	67	124	236	3.2	3.3
Food production, per capita.....	Dol.....	33	38	42	.7	.5
Food production, total ³	Bil. dol.....	66	119	226	3.0	3.25
Net food imports.....	Bil. dol.....	1	5	10	-----	-----
Income elasticity of food ⁴		0.7	0.6		-----	-----

¹ U.N. high population estimates for 1980 and 2000.

² Income growth calculated to balance food demand with food availabilities.

³ Annual growth rate of food production assumed to increase slightly from that estimated in "World Food Budget, 1962 and 1966," Foreign Agriculture Report No. 4, ERS, USDA, October 1961.

⁴ Income elasticity (Arc) assumed to decline with increased income.

TABLE 4.—*Developed countries—a balanced food budget with output restricted to domestic demand plus large exports*

	Unit	Years			Annual rate of growth percent, compounded	
		1960	1980	2000	1960-80	1980-2000
Population ¹	Bil.....	1.0	1.19	1.5	0.9	1.2
Income, per capita ²	Dol.....	900	1,337	1,987	2.0	2.0
Income, total.....	Bil. dol.....	900	1,591	2,980	2.9	3.2
Food consumption, per capita.....	Dol.....	79	85	90	.4	.25
Food consumption, total.....	Bil. dol.....	79	101	135	1.25	1.45
Food production, per capita.....	Dol.....	80	93	110	.8	.8
Food production, total ³	Bil. dol.....	80	111	165	1.6	2.0
Food surplus (potential net exports).....	Bil. dol.....	1	10	30	-----	-----
Income elasticity of food ⁴		0.2	0.15		-----	-----

¹ U.N. high rate.

² See table 1.

³ Food production calculated to balance with demand for food plus assumed level of exports.

⁴ See table 1.

economic growth in the developing countries. Also, there are limits as to how much food can be made available in the form of aid. Commercial imports of food may increase rapidly in absolute terms, but will continue to be limited by the foreign exchange earnings that are possible in these countries at this early stage of economic development. Thus, we can generalize that the rate of increase in output in agriculture sets the practical limits within which the overall developmental process may proceed.⁸ Now let us return to our analysis of a world food budget.

⁸ W. W. Rostow makes the same point in his book *Stages of Economic Growth*, p. 23, Cambridge University Press, fifth printing, 1961.

Projection of a Balanced World Food Budget

1. *The developed countries.*—The assumptions made previously for growth rates of population and per capita real income appear to be realistic for the developed world. Let me repeat them: population to increase 1 percent per year, and real income per person at 2 percent per annum.

The income elasticity of food is projected to be 0.20 in the first period, and 0.15 in the period 1980-2000. Food consumption can therefore be expected to increase only slowly, and primarily as population increases. Food production will be held in check either through lower prices or supply control, or some combination of the two. We can expect a level of food production over

TABLE 5.—*Underdeveloped countries—a balanced food budget with high rates of food production and imports, and a moderate rate of economic development*

	Unit	Years			Annual rate of growth percent, compounded	
		1960	1980	2000	1960-80	1980-2000
Population ¹	Bil.....	2.0	3.1	5.4	2.2	2.8
Income, per capita ²	Dol.....	100	146	209	1.9	1.8
Income, total.....	Bil. dol.....	200	451	1,129	4.2	4.6
Food consumption, per capita.....	Dol.....	34	44	54	1.4	1.1
Food consumption, total.....	Bil. dol.....	67	135	291	3.6	3.9
Food production, per capita.....	Dol.....	33	40	48	1.0	.9
Food production, total ³	Bil. dol.....	66	125	261	3.25	3.75
Food deficit (potential net imports).....	Bil. dol.....	1	10	30	-----	-----
Income elasticity of food ⁴	-----	0.7	0.6	-----	-----	-----

¹ U.N. high rate.

² Income calculated to balance food demand and food availabilities.

³ Assumed that high priority will be given to food production and that output will increase as indicated.

⁴ Income elasticity (Arc) assumed to decline with increased income.

time that will balance with consumption plus exports to underdeveloped countries. If we assume that net exports to the underdeveloped countries (both commercial and aid) can increase to \$10 billion in 1980 and \$30 billion in the year 2000, food production can be allowed to increase 1.6 percent and 2.0 percent per year, respectively. (See table 4.) What we have here then is an assumed massive transfer of food capital from the developed world to the underdeveloped to ease the development problems of the latter and the resource adjustment problems of agriculture in the former. In this exploratory effort, we will not try to resolve the question of financing this transfer.

2. *Underdeveloped countries.*—To this point I have tried to show that with expected trends of population growth and indigenous food output, the per capita real income goals of most underdeveloped countries were unattainable. I shall now make two happy, but I hope not entirely unreasonable, assumptions, and thereby present a development model which suggests a way out of the economic development impasse in which most underdeveloped countries find themselves.⁹ See table 5.)

First, I shall assume that food production in the underdeveloped countries can be induced to grow at an annual rate of 3.25 percent per year up to 1980 and 3.75 percent thereafter. This is a growth rate well beyond the experience of many of these countries. However, it is much less than the rate of production increase experienced in Japan. This small country, with a singular lack of natural resources for food production, increased output 6.4 percent per year from 1952 to 1960. And

⁹ In the analysis that follows, I continue to assume a rapid increase in population. If population growth could be restrained, it would of course be much easier to attain the per capita income goals and a balanced food budget.

according to the USDA's World Food Budget, Eastern Europe, including the U.S.S.R., increased output 4.4 percent per annum and Latin America 3.4 percent per annum during the 1953-60 period. Thus, it is not unrealistic to hope that the underdeveloped nations as a group can increase food output at 3.5 percent or more per year. Stated differently, these countries cannot afford not to achieve this rate of growth in agriculture; they *must* undertake the internal policies and make the necessary investments in agriculture to achieve this rate of growth if their economic development aspirations are to be realized.

Second, I project net food imports from the developed countries to increase markedly to \$10 billion in 1980 and \$30 billion in 2000. At present, net food imports are near \$1 billion, due almost entirely to U.S. foreign food aid. Practical policies in both exporting and importing countries will probably require that part of this very great increase in food movement take the form of commercial trade (although perhaps under some form of long-term credit or concessional terms).

A combination of high domestic food production and massive food transfers results in a much happier picture of economic growth for the underdeveloped world. (See table 5.) Per capita real income is now projected to increase from \$100 in 1960 to \$209 by the year 2000. This is an annual growth rate of approximately 2 percent, rather than the 1 percent or less calculated previously. The higher rate of economic growth in this model rests almost as much on the very great increase in net food imports as it does upon expanded indigenous production.

For those who are interested in the interrelations involved in this kind of analysis, I should like to direct your attention to the relationship between food availabilities and national income

TABLE 6.—*A balanced food budget for the world*¹

	Unit	Years			Annual rate of growth (percent, compounded)	
		1960	1980	2000	1960-80	1980-2000
Population ²	Bil.....	3.0	4.29	6.9	1.8	2.4
Income, per capita.....	Dol.....	367	476	595	1.3	1.1
Income, total.....	Bil. dol.....	1,100	2,042	4,109	3.1	3.5
Food consumption, per capita.....	Dol.....	49	55	62	.6	.6
Food consumption, total.....	Bil. dol.....	146	236	426	2.5	3.0
Food production, per capita.....	Dol.....	49	55	62	.6	.6
Food production, total.....	Bil. dol.....	146	236	426	2.5	3.0
Net food imports.....	Bil. dol.....					
Income elasticity of food.....		0.47	0.52			

¹ In this table the basic variables of tables 4 and 5 are added together for the world total.

² U.N. high rate.

in the two basic models of economic development that have been presented here. (See tables 3 and 5.) Eleven billion dollars worth of additional food (\$6 billion of domestic production and \$5 billion of extra imports) in the model presented in table 5 permits total income in 1980 to increase \$51 billion over the income realized in the situation presented in table 3. Thus, we have a "food multiplier" of 4.6 in this case.¹⁰ It can be argued that this "food multiplier" is not a true multiplier in that the additional food supplies do not *cause* income to increase, but rather permit it to increase. But even so, this concept of a "food multiplier" makes explicit an important relationship about which every developing country should be aware.

A Balanced Food Budget for the World—1980 and 2000

In the models for the developed and underdeveloped segments of the world that have been projected, there is no closing of the wide income gap between the two (compare the per capita income data in tables 4 and 5). This continued disparity is due mainly to the assumption that population in the underdeveloped countries will continue to grow rapidly relative to the developed countries over the period in question. Under these conditions, separate projections for the two segments of the world are much more interesting than a projection for the world as a whole. Nevertheless, for the sake of completeness, the two projections are combined into a world picture. (See table 6.)

In this presentation of a balanced world food budget, total world food production and consumption are projected to increase at an annual rate of 2.5 percent to 1980 and 3 percent to the year 2000. Total real income would grow at 3.1 and 3.5 rates for the two periods. Real income per capita

would grow at a rate only slightly greater than 1 percent per year, with about half of the increased income being spent for food. One interesting observation to be made here is that, with total income growing faster in the underdeveloped countries than in the developed world, the income elasticity of demand for food for the world as a whole actually increases in the 1980-2000 period.

Conclusions

After discussing at length the importance of food and agriculture in economic development, it is time to make a disclaimer. Increased agricultural production is, of course, not the only requirement for economic growth. In certain countries at certain stages of growth, other problems may well be more critical. And such factors as education, political stability, and monetary and financial strength are of paramount importance in all stages of economic development. I have simply tried to give "equal time" to a growth factor that has too often been neglected; namely, the rate of increase in agricultural production.

I derive two major conclusions from the above analysis. First, economic progress in domestic agriculture is a prerequisite to overall economic growth in transitional economies—overall economic development cannot in most underdeveloped countries, and certainly not for the aggregate of countries, progress much more rapidly than the food production base. Secondly, large food transfers from developed countries—involving both aid and trade—can play a crucial role in those countries that find it difficult to increase the per capita production of food to that level required in the development process. If the roll of agriculture in overall economic development can be appreciated in *both* rich and poor countries, then during the next century there is reason for hope—hope not only for food enough, but hope for this whole complex business of economic development.

¹⁰ The magnitude of the multiplier effect will in each case depend upon the income elasticity of food.

Concluding Remarks by the Chairman

YOU now have a more complete picture of the trends in world population, in food production, and in food budgeting.

Let me remind you that the problems of population and production, while generally expressed in terms of statistics, are basically human. They involve not just the bodies of men, but their souls as well.

The man who is starving—and worse still, who must watch his children starve—without hope for ever attaining a diet sufficient to maintain life on a decent level, is condemned to be something less than a man.

The evils of starvation find expression in mounting evils socially, politically, and morally.

Human progress, to this degree, depends heavily upon agricultural progress. Viewed in this light, the work of the land-grant colleges is no technical-degree-factory chore. It is a genuine contribution to man's age-old effort to climb out of the depths of despair onto the mountain of civilized attainment which is his ultimate goal.

May we all through the different agencies of our different governments and institutions rededicate ourselves to this great task—feeding the bodies and minds and spirits of men, women, and children of all races and stations in life everywhere!

PANEL FOUR

"This is the challenge which destiny now gives to the United States Department of Agriculture and the American Land-Grant Universities; to provide the underdeveloped countries the foundation of knowledge upon which to build a productive and prosperous agriculture, within a structure of institutions which will direct their social and political development toward freedom, peace, and democracy". This is the concluding statement by Dr. Erven J. Long in setting the stage for discussion by this panel.

THE WORLD AGRICULTURAL SITUATION AS RELATED TO POLITICAL AND SOCIAL TRENDS

Introductory Statement

Arthur T. Mosher, Moderator, *Director, Council of Economic and Cultural Affairs, Inc.*

FROM THE very beginning of this conference, we have been concerned about world supplies of, and demand for, food, not in isolation but in the total context of current international affairs. So far, however, our discussions have been general—devoted to broad issues in the world at large.

This afternoon, our focus is on the relationships between measures for agricultural development, on

the one hand, and political and social trends, on the other, particularly in the underdeveloped and recently developing countries of Latin America, Asia, and Africa.

We are fortunate in having as participants in this discussion five men with broad experience in a variety of different countries in different parts of the world.

The World Agricultural Situation as Related to Political and Social Trends ¹

Erven J. Long, *Agency for International Development*

IN SPITE OF the fact that we are today celebrating its 100th birthday, the U.S. Department of Agriculture—and its twin brother the American land-grant university—manifests all the vigor, all the enthusiasm, and all the idealism of youth. It is well, indeed, that this is so, because the American people are going to throw upon these twin brothers a task more challenging, more difficult, and more important to our country than that which they did so well the first century of their lives. Their first century was one of fabulous

achievement, which is measured in the oft-quoted superlatives of productivity statistics. The next century will be one of awesome responsibility, which will be measured in the probabilities of our national survival and of the evolution of a world of free and prosperous societies.

The world is entering upon a new phase—a phase of integration of societies, of equalization of opportunities, of determination by all countries to achieve for their citizens levels of economic well-being which the economically advanced nations have demonstrated to be possible. This determined drive for economic progress throughout the world is the central and most important fact

¹ Views expressed are those of the author and not necessarily those of the Agency for International Development.

of today—and will continue to be so until it is either satisfied in accomplishment or completely forfeited in the total collapse of human rationality.

Progress, as an ideal, as a dominant social value, is essentially a modern phenomenon, just a few centuries old. It swept, as an ideal, across western Europe and most exported European societies with amazing speed. In a manner equally amazing, however, it left almost entirely untouched the great masses of people elsewhere in the world. But now, very recently, the drive for economic development has fanned out until it touches the most remote corners of the earth. Now, throughout the world, the ideal of progress is beginning to take shape in the consciousness of the people in the huts, and even in the consciences of the people in the palaces.

It is tempting to believe, or at least to wish, that this progress will be easy to achieve. If only we could merely lend our poorer neighbors money with which to build factories, which would in turn start those countries on an upward spiral of growth. But we know that this is not enough. Our capital assistance can be, at best, but marginal to the countries' total needs. Most of the growth, and of the capital, must be generated from within. Since underdeveloped countries are primarily agricultural, growth must be generated within agriculture. Furthermore, farm incomes must rise to provide purchasing power to absorb increased nonfarm production. It is this task, of providing the scientific knowledge, the technology, and the wisdom needed for agricultural development of the less advanced countries, which destiny gives to the USDA and the land-grant universities for their second century's work. And in accepting this responsibility they will assist definitively in shaping not only the economic but also the political and social character and destiny of the developing nations.

For the drive for progress is not to be denied. The question of the future is not whether economic development will take place—but what form will it take? What forms of social and political institutions will economic development leave in its wake? Will they be structured to achieve such basic values as dignity and freedom of the individual? As the fundamental equality of people? Or will they merely replace old, outmoded forms of tyranny by newer, more effective techniques? Will the powers of science and technology induce economic development by enlisting the willing, creative participation of individuals—or by sharpening the tools of discipline and regimentation?

Institutions, the Key

The underdeveloped, primarily agrarian nations will answer these questions in the kinds of institutions they create to accomplish agricultural development. For let me state the two primary theses of this paper (and these are the only things I have underlined in this paper): (1) *Economic underdevelopment is primarily and fundamentally*

a consequence of institutional underdevelopment; and (2) the fundamental social and political character which will emerge in the countries now about to leap into the stream of economic progress will be determined by the types of institutions they develop for the purpose. Let me dwell a moment on these two points.

Economic underdevelopment is largely an institutional phenomenon—a result of institutions either inadequate or improperly oriented to meet the needs of economic progress. Social, economic, and political institutions of most underdeveloped countries were developed and crystallized out of the characteristics and needs of premodern civilization (and not to survival of the individual but the group). They are addressed not to progress as an ideal, but to survival. They not only fail to provide incentives to the adoption of new knowledge; they often specifically penalize it. For many reasons, these institutions have not adjusted nor developed to meet the demands of (or, more accurately, to create) a modern civilization. Consequently, in such countries, capital does not develop because the institutions which would provide for capital formation do not exist. Human capabilities are underdeveloped because institutions have not evolved which would develop these human capabilities.

Resources are not developed because the scientific, technological, and organizational institutions which call forth—and, literally, “create”²—resources are nonexistent or inadequate. We are much more likely to find the causes of economic underdevelopment in the institutional defects than in the resource deficiencies of a country. For example—and there are many others—the Congo is perhaps the richest country in the world in resources per capita. India has mineral resources equal or nearly equal to those in the United States and agricultural resources adequate to overfeed double her present population.³ Conversely, the resources of Japan and many western European countries are relatively limited.

Frontier Shaped Civilization

As has been pointed out so many times since Frederick Jackson Turner first advanced his famous “frontier hypothesis” in 1893, the basic character of American civilization was determined

² The concept that resources are “created,” rather than merely discovered or exploited, by scientific inquiry—and that the economics of development should be primarily concerned with resource creation rather than with resource allocation—is developed in my paper “Some Theoretical Issues in Economic Development,” *Journal of Farm Economics*, December 1952, pp. 723–731.

³ And, lest we develop a too-simple concept regarding the relationship between economic development and political consequences, it would be well to realize that Cuba was among the vanguard in agricultural development in America when the present government took power.

largely at the agricultural frontier.⁴ The harsh realities of the frontier sifted and winnowed old values, attitudes, and institutions—kept those which were relevant under the new circumstances, and replaced those which were not by new sets of values, new concepts of life, new institutions for organizing human effort.

The thickness of the calluses on a man's hands was a much better clue to his standing in his community than was the length of his traceable ancestral pedigree, and a warm cowbarn was worth more to him than the hyphenated name. The yields of his fields and the warmth of his cowbarns counted for more than did the spelling of his name or the delicacy of his speech. At the frontier, the values of individual independence, and of performance as the measure of worth, were built into an entire structure of institutions which organized individual effort into group action, which channeled private incentive into public purposes, which expanded human capabilities by providing individuals with meaningful mechanisms through which they could in some measure control their own destinies. As these values and institutions were transferred from the frontiers into the cities by the cityward migration of rural people, they were adapted and modified to meet the needs of their new environment and solidified to form, together with their parent rural institutions, the hard skeleton of American civilization.

As the presently underdeveloped countries enter into accelerated programs of economic development they will, perforce, enter also into a period of social and institutional changes—changes as demanding and as profound as those which lay ahead for our forefathers when first they stepped onto American soil. As in the early years of our country's history, the basic social and political character of the emerging nations are now being forged at their agricultural frontiers. Agricultural development of these countries involves different types of frontiers, to be sure—a pushing back of present scientific and technological, rather than geographic, horizons. But massive adjustments of old institutions, and creation of new values, will just as inevitably result from bridging the time gap of centuries of technological progress as they did from crossing the Alleghenies and the Mississippi and from subduing the forests and the prairies.

By far the most far-reaching institutional changes will be those which define the fundamental relations among men—specifically, those essential to realizing the potential capabilities latent in human beings at all economic and social levels. These changes will bite deeply into prevailing systems of social and political organization, and into strongly held values and beliefs.

The drive for economic progress, which is becoming the political imperative of every under-

developed country, makes irresistible demands for increased agricultural productivity. Among the institutions which thwart these aspirations for increased agricultural productivity in many countries is the greater family or joint family system so prevalent in Asia. This system of social organization was admirably suited to its historic purpose of assuring survival of the group. But it does so at the expense of virtually all incentive to or reward for individual effort. Also, by limiting decisionmaking on important matters to greater family elders (even preventing people from deciding when and whom to marry), it greatly inhibits development of managerial competence among the younger people. By the time they have reached the age of authority, their capacity for innovation has long since atrophied. (I recall our cook in India who was 55 years old and couldn't make any decision without running home to his mother, and, if her mother was living, she would have consulted with her.) Tribal institutions in much of Africa have similar implications. The need for efficiency in agriculture may well bring about profound changes in the primary social structure of societies now organized along tribal, greater family, or clan lines. The political consequences will be very different—in fact, perhaps at opposite poles—if this adjustment takes the form of an orderly and gradual breaking-down of tribes and greater families into primary families, such as dominate in our country, than if they are organized into communes or similar social conglomerates.

Even more seriously, development of an efficient agriculture is impeded in many countries by outmoded landownership and tenure institutions. The particular types vary within as well as between countries. The tribal ownership patterns in central Africa—commonly accompanied by shifting cultivation, in which farmers slash and burn the forests, cultivate a year or two and move on, not to return for 10 to 20 years—provide little opportunity for efficiency in farming. Under this system, no capital formation nor investment in permanent farm improvement takes place. In much of Asia, landownership institutions have historically kept the tiller of the land in a condition of complete economic subjugation. In countries where there are few opportunities for employment off the land, those who own the land control thereby those who must make their living from it. The peasant, under such a system, learns that he must not smile lest the landlord think he is too prosperous and raise his rent.^{4a} Such a peasant has little incentive to work hard, and none to invest in his land, as this will merely cause his landlord to raise his rent or to dispossess him for a better paying tenant. In much of Latin America, huge tracts of land, held in private ownership dating back to early land grants, are very slightly

⁴ "The Significance of the Frontier in American History," printed in *The Frontier in American History*, New York, 1920.

^{4a} As an old Asian proverb states it: "A smile on the face of a tenant speaks of the stupidity of his landlord."

utilized or, often, totally undeveloped. Juxtaposed against this are thousands of tiny owner or tenant holdings very intensively utilized, but too small to provide more than bare subsistence. In one country, for example, only about 8 percent of the land on the largest group of farms is under cultivation, as contrasted with over 70 percent of the land on the smallest group of farms.

New Tenure Forms a Must

Caught with the need for increasing agricultural production, countries in Africa, Asia and Latin America will find it necessary to develop new tenure forms. Their choice of tenure policy will have definitive influences upon the countries' future—as was true in our country. Several Asian countries—especially Japan and Taiwan—have conscientiously pursued programs of establishing owner-operated family farms. Productivity increased sharply after these land reforms—about 30 to 40 percent.⁵ But, more importantly, a new social and political structure was born. Tenants who previously had had no access to or interest in citizenship are now landowners who participate actively in local government, and in co-ops, on a basis of equality with their previous masters.

Freed from fear of reprisal from landlords and moneylenders, cultivators no longer get their credit at usurious interest rates; they now run their own credit co-ops. The master-servant relationship between landowner and tenant has been broken, and in its place a social system is evolving, based squarely upon the principle of equal rights of men. India, and several other countries, each in its own way, is striving to achieve similar reforms.

But tenure "reforms" can lead in other directions. As is well known, the Communist countries, far from strengthening family farmownership have sought to obliterate it. This is much more significant than might be supposed. In the Western World the family is the primary unit of social organization. Our social system should be referred to as "familyism"—not "individualism." If the doctrine of individualism in its most rugged form, of "to each only according to his contribution," were really followed, children would all

starve and the race disappear. (I have yet to see a newborn babe earn his own way.) Within the family, it is "from each according to his ability, and to each according to his need"—as the family itself determines. Our agricultural policy, and our frontier history, has deliberately strengthened the family, and this fact has been built into the entire fabric of our society.

Strong "familyism," however, is ideologically repugnant to communism. Therefore, knowing the important role which agrarian institutions play in shaping the general social and political structure, leaders of Communist nations have tried to destroy the family-type farm and the family institution which has undergirded it. They have paid a terrible economic price for this social and political objective, as attested by the continuing food deficits in Russia, the present hunger agonies of China, the essential abandonment of collective farming by Poland and Yugoslavia.⁶ A clue as to the power of incentives in encouraging farm production is found in the fact that the 4 to 5 percent of the land in the Soviet Union which the Government allows farmers to cultivate for their own use "accounted in 1959 for close to one-half of total Soviet meat and milk production, more than 80 percent of eggs, 46 percent of green vegetables, and nearly two-thirds of potato production."⁷ (I wonder how relative statistics would look like, if all the land was worked that way.) It is the great good fortune of the free world that the land-tenure system which contributes most strongly to democratic government is, also, the most productive. It is our great good fortune that Communist ideology and family farm ownership are somehow incompatible.

As the emerging nations make their choices and develop their policies for land-tenure reform, they will in large measure be deciding not only their economic but also their social and political des-

⁵ "... total agricultural net real income (in Japan) increased about 32 percent between the prewar 1934-36 and the postwar 1953-55 period" (Takeo Micawa and Yuzuru Ito, "Capital Formation and Capital Use in Japanese Agriculture with Special Reference to the Effect of Land Reform" in *International Journal of Agrarian Affairs*, January 1958, p. 328). A slightly different expression indicates an increase in production per cultivated acre of 44 percent in 1954-56 over 1933-35 (Mazaru Kajita, *The Land Reform Program in Japan*, Agriculture, Forestry and Fisheries productivity conference, mimeo report, 1958, p. 60). In Taiwan, an analysis of the productivity of the different economic factors shows that the productivity of land increased about 31 percent between 1950 and 1956 (S. C. Hsiaoh and T. H. Lee, "An Analytical Review of Agricultural Development in Taiwan," mimeo report, JCRR, May 14, 1958, p. 25).

⁶ See, *Report of the Study Team on the Working of the Cooperative Movement in Yugoslavia and Israel*, Government of India, Ministry of Community Development and Cooperation, Apr. 9, 1960, p. 25. Also, consider the following statement by the most eminent Yugoslavian economist, Dr. Rudolph Bicanic, University of Zagreb, in commenting upon the "Soviet System" of agriculture in Eastern Europe generally, and Yugoslavia particularly: "The result was that the anticipated economies of scale were offset by other factors such as lack of personal initiative and efficiency in work, lack of flexibility on the part of the centralized management to adjust means of production to their full use. As this administrative change lacked material economic basis, collectivization was carried by coercion and arbitrary measures, and the whole system became degressive and inefficient and had to be changed" ("Lack of Institutional Flexibility in Agriculture," *Proceedings of the 10th International Conference of Agricultural Economists*, Oxford University Press, 1960, pp. 157-178). In the words of still another prominent Yugoslav: "Nobody thinks any longer of collectivization in Yugoslavia" (S. Komar, *The State of Agriculture and Cooperation and the Perspective for their Development*, Federated Peoples' Assembly, Belgrade, 1957).

⁷ Lazar Volin, "Soviet Agriculture: A Continuing Problem," *Current History*, Philadelphia, November 1961, p. 290.

tinies. The political consequences of a country's choice of approach to agricultural development turn largely upon its effect on the nature of the relationship between rural people and government. For a family-farm system is not just a national landscape broken up into relatively small units. It is a system of relationships between rural people and government, a system of institutions dedicated to strengthening the family farm and the farm family. It is a system of governmental relationships to farm people based upon service—research service, credit service, extension service, marketing service, price-supporting service, etc. It is a system which expands the opportunities and power of individual family action by providing means for utilizing voluntary and governmental group action by farmers on those problems which families cannot solve by themselves.

Establishment of such a system of agriculture, in most underdeveloped countries, completely inverts traditional relationships between farmers and government. No longer can the governing be the masters and the governed the servants—quite the opposite. No longer is conformance obtained by prerogative of a ruling minority, but by free choice of the majority.

Attitudes Must Change

So drastic a shift in relationships between the masses of rural people and government is not easy to achieve. It requires tremendous changes in the machinery of government, and, especially, in attitudes of people, both inside and outside of government. Its success often hinges on subtle factors. Let us take the case of a credit program, for example.

In a country whose heritage has been one of subordination of the masses to the will of a ruling group, a credit program administered directly to farmers by governmental officials can easily become an instrument for maintaining complete control of farmers. Credit has been historically, of course, a favored tool of landowners and money-lenders for maintaining both economic and political control over farm people. On the other hand, the same credit, used for the same purposes on the farm, but administered by local farmer co-operatives, may work in just the opposite way—to call government assets to the service of farmers. By making farmers economically stronger and more independent, such credit institutions make them politically stronger and more independent as well. Similarly, an extension program directed merely at distribution of information and supplies may have quite different consequences from one fundamentally dedicated to elevating the competencies of farm families to analyze and solve their own problems. Certainly, an extension service in which local personnel are chosen, and programs worked out, by local farmers has very different political consequences from one in which

the local worker is but the lowest member of a centralized administrative echelon.

This brings me to my final point—the one probably most significant to the political and social destiny of emerging nations. In many underdeveloped countries, economic development aspirations are interrelated with the transfer of political power from a colonizing government to a national self-government. Almost by necessity, these national governments are comprised primarily of people most closely related by education and experience to the previous colonial government. They represent, in a very real sense, a special nonrepresentative elite.

In our own country, this special elite was characterized by an extraordinary quality of thought and of motive. In perspective it can be seen that this elite performed almost a custodian function—to develop the institutions which would prepare the country for the transfer of power to the people at large beginning with what we now call “the Jacksonian revolution.” This transfer of power to an ever-widening base of participation has been the process by which the integration of our society has been achieved and its democratic character secured.

India, to cite a country I know a little bit about, today is working, under similar leadership, with great steadfastness of purpose, and at times almost breathtaking vision, to bring about this kind of transfer of power from the governing elite to the people of India at large. Cases in point are the strengthening of the local units of government (the panchayats), the strengthening of state versus central government, and, especially, the extraordinary efforts to remove disparities due to caste. These are extremely difficult undertakings, because the prevailing institutions of government are primarily imported from Britain, whereas prevailing institutions of the people at large are indigenous—and the two must be brought together in an effectively functioning relationship. Other countries are engaged in comparable efforts at democratization.

Some countries, on the other hand, have had independence from the colonizing government for a century or more; and yet the second transfer of power—from the small nonrepresentative elite to the people at large—has not been achieved nor even seriously undertaken. For them, and for the many other countries which have not yet had time to begin the process—such as the Congo, for example—the hard, rough process of political and social development still lies ahead. And countries pursuing tyranny as an objective are, of course, busily perfecting new techniques and instruments for keeping power away from the masses, and anchoring it securely in their present ruler, and I am sure they are also very anxious to export those techniques as fast as we are anxious to export the techniques of democracy. Perhaps the greatest

challenge and the toughest task facing democratic countries aspiring for economic development is that of achieving this transfer of power to the people at large quickly enough for it to be accomplished in an orderly, nonviolent manner.

This is the challenge which destiny now gives to the U.S. Department of Agriculture and the

American land-grant universities: To provide the underdeveloped countries the foundation of knowledge upon which to build a productive and prosperous agriculture, within a structure of institutions which will direct their social and political development toward freedom, peace, and democracy.

Discussion

Raymond A. Ioanes

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DR. LONG has expertly analyzed a most difficult subject. He has noted that economic underdevelopment traces to institutional underdevelopment. He also contends that the basic social and political character of the emerging societies will be determined by the types of institutions they develop for economic progress.

This fine paper opens up many areas for discussion. I am especially interested in Dr. Long's observation that economic growth must be generated primarily within the agricultural sector. He is right, of course. All too often we forget that despite the low income of agricultural producers in the developing countries of the world, they must be the primary source of capital formation. There are few other sources of income from which savings can be generated.

As the dominant economic factor of the people in underdeveloped countries, agriculture thus must provide most of the capital needed for economic growth. Also agriculture must be a growing customer for industrial goods and services if industry is to develop. Finally, agriculture must provide enough food and fiber to meet minimum needs of the people or provide foreign exchange earnings to see that needs are met. Unless minimum requirements are met, there is price inflation, hunger and malnutrition, political unrest, and slowed-down development.

In view of agriculture's vital role in development, let me ask this question: "Are we, through the Food for Peace program, causing underdeveloped countries to place too much reliance on imported food supplies and not enough on their own resources?" This happens to be a subject of particular interest to me, and I think it is to many of the people in this room, because in one way or the other we feel we have a special responsibility for answering this question. It seems to me to date there has really not been convincing evidence. I am particularly interested in Food for Peace, because my Department has responsibility for administering some important phases of this program.

To date, there has been no evidence that U.S. supplies, furnished on a concessional basis, have sapped the vitality of native agricultures. In the

last 8 years or so we have had plenty of chance to direct agriculture in the underdeveloped countries. And Food for Peace shipments have been quite large, having an export value since 1954 of \$10 billion.

To a considerable extent, political influences in the recipient countries help to regulate the volume of imports. That influence is apparent even in countries where large populations press heavily on available food supplies. These countries, despite chronic malnutrition and hunger, have large farm populations whose economic well-being depends in part on producing and selling food and fiber within their own national boundaries.

India is a good example of what I mean. Our two countries have signed an agreement for the movement of 16 million tons of grain to that country; about 4 million tons a year. In 1960, the United States and India negotiated the biggest single food transaction in the world's history. The United States agreed to provide India with 4 million metric tons of grain a year over a 4-year period. It was stipulated that India would pay in rupees, not dollars, for these supplies.

What happened? Last year India harvested a bumper crop of food grains. Naturally, she gave her own farmers priority on markets, and on transportation and storage facilities. As a result, India's takings dropped off from 5.0 million tons in 1960 to a little more than 2.1 million tons in 1961. She had demonstrated that she had uppermost in her own mind the proper shepherding of her own producers.

Food for Peace is strengthening the will and the capacity of free world peoples to stay free. Also, good will is being created—a consciousness among millions of the world's people that others want to help them because, as President Kennedy puts it, it is right. This abundance must be causing the uncommitted, underdeveloped countries—largely agricultural—to make comparisons between the agricultures of free and regimented countries.

Two Systems Compared

In their recent actions and statements, the Communists themselves seem to be admitting that the

land tenure and landownership system of the free world, with its emphasis on the family farm and reasonable economic incentives, is the most productive system possible. Within the Communist world itself, it can be seen that freedom and incentive mean a more abundant agriculture. Russia, whose land is either in collectivized or state farms, publicly admits that failures in its agricultural sector are by far their No. 1 economic problem. In Poland and Yugoslavia, where private ownership and control of farms is the general rule, farmers have made a substantial contribution to the economic growth of their countries. They have had the incentive to do so not only for material reasons but also because of the fierce pride and stimulus provided by a free system of agriculture.

Turning now to the situation in developed countries. And I mean to do so merely to add a little rounding out to this whole process. I certainly agree with Dr. Long, our major emphasis should be on the underdeveloped countries. I would like to recall that these countries do not, of course, have the problem of having to extract development capital from an underdeveloped agriculture. But their agricultural situation does present problems, too, and social and political trends have determined the manner in which they deal with them.

As we all know, advanced societies have come to accept quite generally the notion that segments of their economies cannot be simply left to their own devices if adverse circumstances hit them. I might add that they have not only come to accept this notion but also can afford it. Thus, we have policies for full employment and we have policies of social security and policies of graduality for adjustments to changed circumstances in domestic

markets, in domestic costs, in exports and in imports.

Agriculture in the industrial countries has for some time been affected by a technological revolution that has almost become an indispensable force for expansion. At the same time, that agriculture is faced with growing inelasticity of the demand for its products and it is faced with atomistic competition among millions of producers who cannot, like industry, easily respond to basic changes in markets or costs. Therefore, governments feel that they must do for agriculture what industry can do for itself acting individually or in concert. This is the basic reason why we have agricultural protection in all industrial countries.

The social and political trends both in the less developed and in the industrial countries, however, also warn us not to go overboard in efforts at promoting industry here, and protecting agriculture there. Agriculture must not be neglected in the developing countries, and must not be over-protected in the industrial countries. National policies must recognize the growing interdependence of the economies of the world. This, of course, means the promotion of policies to maintain and expand international trade in both industrial and agricultural products. All of us must strive to keep our policies trained on the reasonable and the internationally acceptable and to contemplate the broader interest of our nations as being served indirectly by policies of international cooperation, division of labor for greater efficiency, and greater all-round social welfare.

In this manner we will make sure that the policies of development and protection that are so intimately related to social and political trends promote rather than impair economic growth and expansion.

Discussion—Continued

Jose Marull

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LET ME BEGIN by commending Dr. Long for the highly stimulating paper he has presented here. In it he spells out the challenge posted to professional agriculturists in helping to shape rural institutions which will contribute positively toward strengthening democratic forms of life in developing countries. I fully subscribe to his view that the political and social end product of development will be determined largely by the types of institutions evolved in the process.

As his statements are applied to Latin America, they become inextricably entangled with Alliance for Progress. This pact signed last August in Punta del Este, Uruguay, establishes the framework within which the countries of the Inter-American system are looking for an assurance of

a better life through democratic institutions for the present and future generations. In it, the countries pledge themselves to attain in the coming years, particularly in the next decade, specific goals such as: wiping out illiteracy; making primary education available to every child and raising annual per capital income by 2.5 percent. Simultaneously, they want to increase the span of life by means of health programs; improve labor relations and working conditions; keep a healthy monetary policy; stimulate private activity; promote housing programs; speed up economic integration; stabilize and improve the international terms of trade; establish tax and land reforms; perfect and strengthen democratic institutions particularly applying the principle of self-deter-

mination of the people. They are committed to undertake the vast social and economic changes by themselves, but the United States has promised technical and financial cooperation to help them achieve their goals in time.

What chances of success has the Alliance for Progress? There are many encouraging facts in the horizon, but also one could compile an impressive list of obstacles that will need to be overcome.

For instance, rising expectations, in my mind, are the direct result of modern communications which made the world at large conscious of progress attained in the most developed countries. Undoubtedly, it was desirable to advertise higher levels of living, the joys of being well housed, well fed, well cared, well clothed. It was also good to hammer the idea that chronic poverty could be avoided. But unfortunately, somewhere in these motions of showing the rest of the world what the most advanced countries had accomplished, an important part of the message became lost. Underdeveloped countries were not forewarned of the price to be paid for progress, that the good things of life must be earned. Communications whetted their appetites but failed to impress on them the responsibility involved in the pursuit of betterment. In several countries a strong feeling is detected nowadays in the sense that developing the rest of the world is the duty of the most advanced countries. An enormous task of education is needed, first to convince the oligarchic groups that their own survival requires yielding now a little to evolution in order to avoid losing everything violently to a future revolution. It means convincing them to ease their grip on political power, opportunity, and wealth. The masses also need to be enlightened into learning how to wait, how to advance in an orderly fashion; they need to be shown that equalization at present means mainly distributing poverty. But above all, those that are in position to guide public opinion through press, radio, movies, etc., need to have a thorough understanding of the situation.

Somewhere along the road the label "backward" was tagged on to a group of countries. It was subsequently replaced by underdeveloped, but still rubs Latin America somewhat the wrong way. It tends to classify countries into have and have-nots, a kind of subtle elongation of the Marx class lines into the realm of international relations. As we insist on marking some countries as officially poor, their emotions are stirred to look for either a scapegoat, a shortcut to prosperity, or a compensation for the injustice that their poverty represents. Like adolescents, underdeveloped countries show a wide margin in their indicators of economic, social, or political maturity. Like them, they have a fierce sense of dignity as well as a yearning for self-assertion and recognition. It is

well to remember in this connection that human values do not rank in the same order everywhere.

Economic development does not automatically produce nice people. Unless properly guided, the hurdles will prove insurmountable. In the first place, the countries must rise from a very low level. In Latin America, average income per capita is about one-eighth of the figure for the most developed countries. In turn, agriculture is one-third of the Latin American average. But not only is the sheer size of the gap to be bridged a staggering task in itself. Social, economical, and political progress have to be telescoped in the span of a few years. All this in the midst of a struggle between democracy and communism, while impatience mounts in a population that is expanding at such a pace that most gains are canceled out. Extensive sectors of rural Latin America are ripening fast to fall prey to Mao's successful recipe for seizure of power. In fact, there is a large peasant population, there is terrain suitable for guerrilla enclaves, plus abundant opportunities for united front tactics, as well as plenty of dissatisfaction that could be manipulated by the hard core of highly dedicated and trained professional revolutionaries ever present. Let me underline "dedicated." We are still missing their full counterparts on the democratic side. Is Peace Corps the answer?

Institutions such as agricultural extension are falling short of their expected roles. Is it due to the transplantation without the backlog of accumulated research from an environment of family farms to an agrarian structure of extremes in sizes? One of the largest Latin American countries which has perhaps the best extension service in the region is reaching only 1 percent of the rural families and not the right ones. There has been practically no impact on the economy of the country and the main problems are still unsolved. Monetary inflation and militarism further complicate the picture.

On the positive side, fortunately the United States has seized the initiative and we hope will continue to offer leadership of a high caliber. This leadership has taken concrete form in the Alliance for Progress, the Inter-American Bank, the Agency for International Development, and the support of international agencies and foundations. There is an emergent middle-income group that still needs to be doubled in size that is already offering promises of broadening the base of government. Industrialization and economic regional integration are making progress. There is a tiny but important beginning of training political leaders in the democratic field at the Instituto de Ciencias Politicas in Costa Rica. At the Inter-American Institute of Agricultural Sciences the highest priority in its activities for the coming 5 years has been assigned already to an intensive analysis of the institutions and programs con-

nected with Latin American agriculture in an effort to find out why these institutions have not operated properly and what advice can be given to the interested governments in order to improve their performance.

We hope the armed forces in Latin America and the Catholic Church will fully realize the magnitude of the challenge and the magnificent opportunity they have to work toward the well-being of these countries.

Discussion—Continued

A. R. Sidky

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IT IS INDEED an honor and a great privilege to be invited to participate in the celebration of the Centennial anniversary of the U.S. Department of Agriculture. I am happy to join the workers in the field of agriculture and related activities who pay tribute to the pioneering work of this Department and the excellent achievements so far accomplished, and who also bear testimony to the useful experiences and benefits that the farmers in the United States and in many other parts of the world have gained from these services in enhancing their economic and social welfare.

The basic theme of this panel, as I see it, is the interrelationship between underdevelopment and the institutional structure of the farming community, and in turn the fundamental role of this structure in shaping the social and political character of underdeveloped countries, or vice versa. I hardly need to say that my training and present occupation do not permit me to discuss the political aspects of the question and therefore I will devote myself to the socioeconomic aspects.

Looking in retrospect, historical evidence emphasizes three fundamental and basic concepts that enabled many countries to reach their present and advanced levels of development. These are the close association of the rates of economic growth with the functional activities of these countries, the role of agriculture in expediting their transition into higher stages of development, and thirdly the influence of the agricultural institutions in the shaping of the entire structure of the society. Again, based on historical comparison, it is evident that this process of growth in the now developed countries was spread over a relatively long period of time and it functioned undirected until it adjusted its course in reaching its objectives in productivity and social equity. The contention, especially in certain countries, was that there was sufficient and abundant resources that any development was bound to bring progress, provided, of course, it is within the bounds of law and order. The emerging countries of today consider this procedure too slow and often too spotty and thus do not adopt it. This is particularly true for those countries which have acquired their political independence, and wish to effect a rapid and contemporaneous socioeconomic

independence as well, so as to provide a better way of living to the masses of people. In agriculture, for example, this latter form of independence in many cases is jeopardized by the existing maldistribution of landownership often used as a tool to maintain an internal political pressure as well as by the inefficient exploitation of the land. In many cases also, these countries are faced with a relative paucity of resources and an ever-increasing rate of growth in population, accelerated in some cases by better sanitary conditions and disease control; which bring into focus an element of urgency to expedite developments. On the other hand, these countries believe that they can induce and accomplish progress more rapidly, especially as they can benefit from the reservoir of innovations and avoid pitfalls and difficulties that were encountered by their predecessors. This again is justified by historical evidences when studying the rates of growth of the developed countries in the past and the speed with which they transformed their economics from pastoral agriculture to advanced stages of secondary and tertiary occupations.

All these aforementioned considerations have led developing countries to look toward comprehensive planning as a basic tool to achieve rapid and healthy growth. This is probably one of the most striking features in recent years, judging by the number and intensity of the national development plans that have been introduced lately or that are in the process of formulation, especially in the Near East. Ladies and gentlemen, I realize that planning for economic development is a subject for discussion in another panel, but I propose to briefly describe here some of the salient features of modern planning as they have a direct bearing on the subject of this panel; namely, as they affect the social and economic transformation of the rural societies.

Modern Planning

In contrast with the prewar and immediate postwar developments, when the plans were little more than aggregates of projects and where the targets were mainly for public investments and were distributed and phased on a relatively rough and ready basis, the modern plans cover all sectors

of the economy. The private sector is brought into the picture and the diversification in the entire economy became a primary objective for a gradual transition to more advanced stages of growth. I say "gradual," as economic and social growth does not imply to abandon agriculture but to introduce fundamental changes in the shape of the production function of agriculture itself that enables the other sectors to play an increasingly important role in the economic and social life. Especially in the developing countries, it is realized that if a predominantly agricultural economy is weak, it is often because of the unused potentials within agriculture itself, and to promote this sector is likely to enhance the economy more rapidly than otherwise, especially in the initial periods. A healthy feature of nearly all the new plans is their recognition of the interdependent nature of agriculture with the other sectors of the national economy. This is clearly expressed by the dominant role that agriculture continues to play in nearly all the new development plans.¹ These new plans also emphasize the complementarity of economic and social developments, and the need for their integration to achieve growth in a balanced, self-sustained, and cumulative manner. This is certainly the first and most important challenge to agriculture and general economic development. It must be realized that only a very limited number of problems could be solved "in vitro" or in isolation, and that the permanent solutions to almost all economic and social deficiencies, be it in agriculture or otherwise, could be expected only when each problem is considered as a function or as an equation within a general structure and when the sector in question forms an integral part of the national economic and social picture.

To translate these general objectives and strategies into well-formulated national plans, capable of effective implementation, require substantial-improvement of the existing machineries and organizational structures. In fact, it may even require an almost total transformation of the entire socioeconomic fabric of the society. This is probably a major function of the modern societies if not their first and primary objective.

The primary function of planning is to change an economy from confining itself to the maximization of natural output to one that attracts and maximizes the resourcefulness of man himself, and to coordinate his activities in the exploitation of nature's wealth for his own economic interest and for the welfare of his entire society. In certain cases this is achieved by modern legislation and a proper organization of labor-management relationships. In other cases, it may even lead to the redistribution of wealth itself, especially if this is

limited in relation to the population. Examples of this latter approach in agriculture are found in the varying agrarian reforms that are being instituted throughout the world, including the Near East. Agrarian reform is not only limited to the redistribution of wealth which in itself is often necessary to create a proper economic balance. It is also intended to encourage social consciousness throughout the community and a greater sense of rights, obligations, and responsibilities among its members.

A Basic Role of Education

Of course, when a member of a society is called to participate more closely in building up this society and especially when he becomes, you may say, "a shareholder" in it, he is called to assume new responsibilities. He should be sufficiently prepared for this lest he misuses wittingly or otherwise these new rights and obligations. Here comes the fundamental and basic role of education in all its aspects. It is, however, an expensive undertaking and also time consuming. The question that arises therefore is whether to maintain the *modus operandi* of balances or rather unbalances in the socioeconomic and political structure until the society is sufficiently educated, or whether to effect the required changes forthwith and hope that these new members of the society will assume their new obligations and learn through trial and error.

The former approach is nothing less than economic and social stagnation if not retrogressive, while the latter may endanger the entire society. Instead, many countries found an alternative way to enforce a massive approach to education and to introduce the necessary transformation of the society as warranted and at the same time and especially in the initial period by expanding the public sector, which will also contribute to the newly organized society in the decision, planning, and execution of their new responsibility. Contemporaneously and in the case of agriculture, for example, supporting services are introduced or expanded for self-help and mutual aids to the farming community. These take the form of stronger cooperative organizations, expanded credit facilities, better marketing procedures, and wider extension services. In many cases this is also enforced by the creation of local governments or by the strengthening of existing administrative and local government units whereby the various communities have a greater role to play in solving the local problems. There is also the consensus of opinion that all concerned in the economic activities of a country reaching to the farm level, in the particular case of agriculture, should pool their resources, knowledge, and experience, and participate in the planning process. These organizational structures and the dual responsibilities of the public and the private sectors are established at all stages and levels, whether in the

¹ In his plenary session talk, Dr. Egbert deVries indicated that the Middle East ranked first among other regions of the world in the increase of food production between 1934-38 and 1960. Also, he indicated that Egypt was among the few countries where food production kept pace of rapid increase in population.

process of formulation or in the course of implementation. This is mainly contemplated to devise and coordinate all the measures at the disposal of government agencies and private bodies in order to make the best use of a nation's human and natural resources for the maximum wealth and welfare of its inhabitants within a context of social justice and human dignity. One of the major factors that hinder progress in the formulation and implementation of these plans and objectives is the lack of technical knowledge. It is principally here that bilateral and international assistance could be very effective, especially when it

is focused to the most important development needs of the recipient countries and when suggestions for their solutions are made in a rational and practical approach and adapted to local conditions and objectives rather than to suggest the indiscriminate application of the methods, views, measures, and the like that have grown up elsewhere. It is furthermore necessary that outside help and advice is rendered within a magnitude and dimension of self-help as emerging countries are anxious to solve their own problems and to run their operations by themselves as free responsible people.

Discussion—Continued

Clyde T. Ellis

General Manager, National Rural Electric Cooperative Association

I AM HONORED to participate on this distinguished panel, and to join all of you in this commemoration of the U.S. Department of Agriculture Centennial.

Perhaps more than most people in America, my associates and I feel a close kinship with the Department and its agencies. We know firsthand the tremendous thrust the Department has given to programs of social and economic growth in America and the world.

We have been an integral part of what many consider one of the most successful undertakings of the Department of Agriculture—the electrification of the vast and lonely reaches of rural America.

We speak here of the relationship between agriculture and political and social trends. It is my considered judgment that few programs ever launched by a free society have had such far-reaching effects on political or social realities as the rural electrification program of the United States.

Let me first give you some impersonal statistics. When the rural electrification program began in 1935, only 10 percent of the farms of America were electrified. Today, 98 percent have electricity. A substantial majority of these farms are served by systems financed by the Rural Electrification Administration. Some 1,000 rural electric systems, mostly cooperatives, serve 5 million rural homes and establishments—bringing the wonders of electricity to some 20 million Americans.

In 1935, there was nothing—now there is a great and going program with incredible achievements, and the organization and determination needed to face the problems of the future.

In 1935, there was darkness and despair and poverty on the land. Today, there is light and power and hope—and the most serious problems are the problems of plenty.

This transformation of rural America has progressed step by step with rural electrification.

Can you imagine any rural program—be it price stabilization, rural areas development, rural renewal, or anything else—that would matter much if there were no rural electrification?

And it is certainly true that rural electrification is good for all Americans—regardless of where they live.

It is a tremendous economic stimulant. The Rural Electrification Administration has a formula which indicates that for every dollar the agency lends, the people who receive the power spend \$4 for house wiring, appliances, and equipment. By this standard, more than \$20 billion has been pumped into the economy, and our own surveys show our members are currently spending \$1 billion a year for major appliances alone—and that this will continue indefinitely, for these people who serve themselves with electricity continue to double their use of it about every 5 years.

Think what this means in income to the people in the towns and cities which are engaged in manufacturing all the products which go into the making of this equipment.

The people benefit, too, by the better quality of the food they buy. Without electricity on the farm, there could be no grade A milk and no poultry industry as we know it. And prices of meat would be higher and quality poorer. Health and sanitation standards would be lower. A major link would be broken in the chain of agricultural progress which has produced an abundance of high-quality food at low cost.

These are some of the reasons we say rural electrification is good for all Americans—why it would be good for all the people of any country. Rural electrification pays its own way—many times over.

So much for the economic accomplishments of the program. Earlier I said it has had great political and social significance, and I would like to tell you what I meant.

Political and Social Significance

First you must realize that the Rural Electrification Administration is primarily a lending agency. It does not own 1 mile of electric line or sell 1 kilowatt-hour of power. This is done by the organizations which borrow from REA. Some are public power districts and a few are commercial power companies—but the overwhelming majority are consumer-owned cooperatives—organized for the specific purpose of distributing electricity on a nonprofit, area coverage basis. The cooperatives, in turn, have joined together in State, regional, and national federations—applying their collective strength to common problems.

Thus the success formula for rural electrification has been this—Government financing, promotion and technical help, combined with local initiative, ownership, and responsibility, plus the ability of individual organizations to work together in federations.

This is a practical application of the Abraham Lincoln concept that the proper role of government is to help the people help themselves to do things which they need to have done, but which they cannot do at all, or do as well, for themselves.

The great political and social implications of this concept of government are obvious. In the rural electrification application of this principle, some 1,000 strong, and free, democratic institutions have been established throughout America. Through their own locally owned and operated cooperatives, rural people provide themselves with a basic service which most of them could not get from any other source.

Once a year the members of each system gather to transact business, establish policy, and elect from their number a board of directors.

This means that 5 million member-consumers actively share in the ownership of America's rural electric systems. And they share also in the responsibilities which ownership imposes. With their families, the result is that some 20 million people are closely involved in the democratic process at a meaningful level.

They also have long since discovered that the Federal Government can be a working partner in progress without dominating the enterprise. Our people are eager to utilize the Federal programs, but they maintain their individuality and independence of action.

And it is also true, of course, that the broad interests of our program are affected by congressional and executive actions. This fact has given our people a sharpened political awareness.

All of these things, we think, contribute to the relationship between agriculture and political and social trends in this country. All of them, we know, strengthen the American democracy.

Exporting the REA Idea

In recent months our people have given considerable thought to what we call the "export of the REA idea." It has seemed to us that if rural electrification could contribute so much to the strength and progress of America, it should be able to make a similar contribution in other countries.

It has been well said at this meeting by Mr. Long and others that growth in most of the underdeveloped countries must spring from agriculture. The poor people of the world are mostly poor farmers. In most areas, they are poor politically and socially as well as economically. What is clearly needed are programs to inject new hope and potential into the rural life of these countries.

Our farm people are beginning to identify with the farm families of other lands. In the success of rural electrification in their own communities, they see a possible pattern for others. They're asking: "What can we do to help?"

They have instructed their national service organization to work with the Agency for International Development in evolving new programs.

Let me tell you some of the things we have already done:

In June of last year, our national board of directors instructed the staff to "call attention to the appropriate agencies of the U.S. Government the great potential offered by the REA pattern for advancing international social and economic progress."

We began working along these lines. Soon the old ICA set up a special advisory committee on cooperatives, with the general manager of NRECA as a member. Then, in September, Congress included an amendment in the foreign aid bill to "encourage the development and use of cooperatives, credit unions, and loan associations" as a feature of the foreign aid program.

In November, seven of us from the rural electric met with representatives of cooperatives of all kinds in the Western Hemisphere at a conference in Bogota, Colombia. There we discussed methods by which cooperatives could promote economic and social growth in this hemisphere. We took steps to form two hemisphere federations—one for general self-service and one for financing.

Following that conference, AID asked several of us to undertake an official study tour of Latin America, to see just how cooperatives might fit into its program. We returned enthused by the great potential for cooperative action in every country.

At the national annual meeting of the National Rural Electric Cooperative Association in March of this year, our 5,000 delegates went firmly on record as urging the fullest use of the REA pattern in the application of our Government's overseas programs. They also indicated their desire to con-

tribute their know-how and experience in cooperative and rural electric programs overseas.

We have worked closely with AID in the development of several pilot projects. One of our Indiana cooperative managers is now in Nicaragua to make an engineering study for a rural electric cooperative. Funds have been allocated, and we have recommended another man for an economic study of possible rural electric cooperatives in Ecuador. We have been asked for help in establishing rural electric cooperatives in Brazil, Bolivia, Honduras, and Colombia. We have submitted a program to AID which would help establish pilot projects in those countries. We also propose to send consultants to other countries, and participate in inter-American cooperative training programs.

Our initial experiences make us even more certain that we're on the right track. Studies indicate that some rural electric cooperatives in the Latin countries are now economically feasible—more feasible in some cases than many in the United States when they started.

Cooperative Principles Strengthen Democracy

We are convinced, too, that cooperative principles will strengthen democracy and the cause of freedom in these newly developing countries. Wilfred Mast, our engineer on the Nicaragua pilot project, writes with gripping emotion of the experience of the people there in speaking freely and voting by secret ballot in the organizational meetings. He described the feeling of pride and the joy of belonging which pervaded the group. "As I watched," he said, "I felt that this cooperative must be built regardless of the sacrifices that must be made."

This is also our feeling. Our people are proud that the government which has done so much *for* us now asks something *of* us.

We doubt that the fight for freedom will be won by slogans or speeches. We think it may be won by positive programs which attack the root causes of political and social unrest. We believe rural electrification, provided by local, democratic organizations, will make a major contribution throughout the world.

PANEL FIVE

"We are convinced that the world has the natural and scientific resources to feed its people today and for many years to come. We are equally convinced that victory against hunger will come only as nations and individuals acquire the vision, the will, and the spirit of cooperation necessary to plan and carry out so mammoth a task." In these words, Dr. Byron Shaw, Administrator of the Agricultural Research Service, USDA, closed this session. In his remarks, the principal speaker on this panel, Dr. D. P. Cuthbertson, said in part: "What should be scientifically a vast and theoretically soluble problem of bioenergetics is . . . bedeviled by the makeup of man himself, who creates the problem. Can his agricultural production . . . catch up with population growth?"

THE WORLD AGRICULTURAL SITUATION AS RELATED TO KNOWLEDGE OF SCIENCE AND ITS APPLICATION

Introductory Statement

Byron T. Shaw, Moderator

Administrator, Agricultural Research Service, U.S. Department of Agriculture

At no time in history have all people everywhere been adequately nourished. Yet the world has the soil, water, and sunshine to produce several times the amount of food that is being produced today.

We recognize, however, that it takes more than these physical resources alone to provide nutritious diets for everyone. Putting food on the world's dinner table requires the efforts of hun-

dreds of millions of people, concerned not only with production but also with processing, distribution, and consumption of food.

The job deeply involves science and technology, applied on a worldwide scale. This is the topic for our discussion this afternoon, "The World Agricultural Situation Relating to the Development of Science and Its Application."

The World Food Situation as Related to Knowledge of Science and Its Application

D. P. Cuthbertson

Director, The Rowett Research Institute, Bucksburn, Aberdeen, Scotland

THE BASIC PROBLEM is that half or more of the world's population is underfed or malnourished; that the world's population is increasing very rapidly; that more food is needed to feed more people with better diets; that land resources available to this end are very limited; that input re-

sources to raise yields are also limited and depend to a considerable extent on industrialization, education, and social factors. What should be scientifically a vast and theoretically soluble problem of bioenergetics is, as Duckham (1960) has pointed out, bedeviled by the makeup of man him-

self, who creates the problem. Can his agricultural production, which tends to be linear in its growth, be made exponential to catch up with population growth? Can he limit his rate of multiplication to match his production? Malthus thought that science could solve the problem. This is our concern today.

Just because of his multiplicity of environments, of his religious creeds, taboos, and superstitions, man has provided many experimental demonstrations of his ability to live and multiply under diverse systems, though frequently at a much reduced potential and with diminished expectation of life.

Looking at the course of world events it would appear that by entirely understandable steps the scientific industrial revolution has multiplied by 10 or more the material wealth of about a quarter of the world's population and in doing so has greatly increased the production of food—in some countries hugely. The other three-quarters are setting out on the same road and are in a hurry.

Advances Must Constantly Be Sought

The existing level of scientific technology is, in the main, amply sufficient to allow the solution of the world's food problem over the next few decades by the wide application of known methods. But further scientific and technological advances must continually be sought and not simply looked on as windfalls.

Primitive agricultural and social systems must give way to new systems supplied by a complex chain of chemical and engineering industries. This integration all requires education and an understanding of the peoples' sociology. The existing systems will inevitably displace people—more will become landless and new industries will require to be established to absorb those no longer required.

It is estimated that about 60 man-hours of labor are needed to produce 1 hundredweight of grain by African methods as against 1 or 2 man-hours on a modern, advanced farm.

Lack of indigenous drive and lack of acceptance by governments that they have duties other than the preservation of law and order are real obstacles to progress.

To raise rapidly the standard of education so that taboos and superstitions can be examined dispassionately and so that advantage can be taken of the revolutionary changes that are awaiting exploitation, new pedagogic methods must be devised. More of the highly educable portion must become interested in the natural sciences and in chemistry.

If favorable conditions for attracting and retaining scientists, technologists, and, above all, of producing agricultural general practitioners of the necessary caliber can be assured, there are solid reasons for believing that the problems of hunger and malnutrition in our time will be solved by the

application of existing knowledge. But just as we inherited the fruits of experiment and imagination of our predecessors, so we, in turn, must through objective basic research be looking to the solution of the problems of those who will succeed us.

Basic or fundamental research is designed to discover new scientific principles. When directed to agricultural problems, we can properly speak of objective basic research. Applied research tests principles under a variety of conditions and finds the best mode of application for a specific problem.

The degree of emphasis placed on one or other of these two categories depends in part on the type of training and quality of research personnel, the financial resources, and the technical facilities available. The developed countries are better placed to carry out basic research, and have, in fact, produced a large number of discoveries which await application or adaptation to conditions in less-well-developed countries.

Both Basic and Applied Research Needed

The urgency for agricultural improvement is such that in less-well-developed countries the bias will be toward applied research, but the two types of research are far from being clear cut, for very frequently the problems are such as to make demands on both basic and applied research teams.

It has been pointed out that frequently there is a lack of pooling of research knowledge between educational institutions and the research services proper. Secondly, there appears to be need for a greater emphasis on farm management research; that is, paying attention to the farm business organization as one economic unit. This would help in the formulation of realistic government policies covering credit, land use, and the training of personnel, as well as agricultural prices.

There is not yet in most countries a sufficiently clear order of priorities between research projects, and in fixing projects and priorities more weight could be given to the farmers' needs.

The Food Situation

By and large, food deficits are greatest in countries that have the least means of obtaining adequate supplies. Total calories, total proteins, and particularly animal proteins, are, on the whole, very low for the populations of western Asia, Africa, the Far East, mainland China, and large parts of Latin America.

The effect of shortages of calories and protein, especially animal protein, is to make their populations more vulnerable to certain deficiency diseases and to reduce the vitality and energy that are necessary for national development. These shortages have been assessed by the Foreign Agricultural Service of the U.S. Department of Agriculture (1961) by applying nutritional reference standards based on those developed by FAO, and these range from a needed daily consumption of

2,300 kilocalories per person in the Far East to 2,500 kilocalories in Latin America. The protein reference standard was set at 65 grams total protein per person per day. Of this it is reckoned that at least a tenth, or 7 grams, should be animal protein, and total animal and pulse protein should equal at least 17 grams.

In Wright's view (1960), half of the world's population is underfed or malnourished. This would appear largely to be based relative to nutritional standards enjoyed by the people of the United Kingdom and France. This lull may fluctuate between 20 and 70 percent. Owing to lack of variety, in particular of animal protein, the diets of the less-well-developed countries tend to lack a sufficiency of the essential amino acids, vitamins, and minerals essential for growth, maintenance, reproduction, and recovery from disease. In view of this, the generally accompanying deficiency of calories has helped to restrain growth which might otherwise have led to warped bodies.

In the Temperate Zones on mixed diets, Starling's dictum holds generally: "Take care of the calories and the protein will take care of itself," but not so where the staple foodstuff has low and imperfect protein as in cassava and yams. But, on the whole, it is remarkable how constant this proportion of protein (as calories) generally is at all levels of energy expenditure, pregnancy, and hard work. People eat, more or less, the same pattern of foodstuffs.

TABLE 1.—Percentage of calorie supplies from carbohydrates, protein, and fat in average regional diets

Region	Percentage of calories from—			
	Carbohydrates	Proteins	Fats	Total
Far East.....	78	10	12	100
Near East.....	74	11	15	100
Africa	71	9	20	100
Latin America.....	69	10	21	100
Europe	65	10	25	100
North America.....	51	10	39	100
Oceania	54	10	36	100
World	71	10	19	100

Sukhatme, 1961.

The most critical shortages of animal protein are in the Far East, followed by Communist Asia and by Africa. Nearly all the pulse protein is located in Africa and the Far East. The Far East is the world's primary food-deficit area; particularly, it needs to add protein. Considerable deficits also appear for Africa and some of the Latin American Republics.

The Foreign Agricultural Service of the U.S. Department of Agriculture (1961) has expressed the world's gap between the amounts of food that people in deficit countries have available, whether domestically produced or imported, and the larger amounts of food desirable to maintain normal physical activity and health, and this refers to ap-

proximately half of the world's population. In these terms, based on the year 1962, the estimated food shortages in the world's deficit countries have been calculated to be the equivalent of:

	Million metric tons
Animal protein in terms of nonfat milk solids.....	1.8
Pulse protein, in terms of dry beans and peas.....	0.4
Other protein, in terms of wheat.....	35.6
Remaining calorie deficit, in terms of wheat.....	8.6

Sukhatme (1961) considers that the total supplies of cereals in the Far East would have to be more than doubled, and those in animal products increased to six times their present size, in order to insure a reasonably adequate level of nutrition to its people by the year 2000. For the world as a whole, the broad conclusion is that, should population grow according to the United Nations medium forecast, the food supplies would have to be more than doubled by 1980 and trebled by the turn of the century.

Strange Preferences, Religious Taboos

Deficiency in energy intake—hunger—can be relieved in principle fairly simply by producing more of the usual crops. But malnutrition is more difficult: it arises from imbalance in the diet and is more widespread. Possibly about half the world's population suffers in one or other respect (Sukhatme, 1961; Wright, 1961). In extreme cases, as in kwashiorkor in infants, the symptoms are obvious enough, but where the deficiency is milder there may be a rather nonspecific lack of energy and "ill thrift," as we say in agriculture. The most common defects are largely of an inadequate supply of some of the essential amino acids which are contained in more appropriate amounts in the proteins of milk, eggs, fish, and meat, and of some of the vitamins in these foodstuffs.

There are some strange preferences, some curious prejudices and religious taboos which exclude many useful sources of the nutrients needed for health (Cuthbertson, 1962). These prohibitions, too numerous to be mentioned here, are an integral part of the lives of the people and, unless they change their religion or ideology, are unlikely to be set aside on nutritional grounds. Alternative methods of supplying the lacking nutrients must be sought. Some of these, like dried milk in Africa, are more readily accepted for the vulnerable fraction of the population. Acceptable protein or amino acid sources which will supplement the normal diet must be found. Soya bean is very useful, but in the Tropics it flowers before it has time to make much growth. It would be useful to find plant hormones or substances capable of controlling its growth.

The problem of malnutrition in Africa is further complicated by the fact that numbers of animal stock rather than condition are the symbols of wealth and position. Proper marketing should ease this situation.

Food Production and Population

Although per caput food production for the world as a whole (excluding mainland China) is, according to FAO (1961c) now some 14 percent above the prewar level, which was regained in the years 1948-49 to 1952-53, the improvement has been largely in the more developed parts of the world, where population growth is tending to slow down, in contrast to the accelerating rates in less-well-developed countries. The Near East is the only one of the less developed regions where production has been consistently maintained during recent years at more than prewar level per head. Israel is a shining example of the application of a highly educated people to a relatively difficult terrain. Turkey and Egypt also enjoy a better standard.

In the Far East (excluding the mainland of China) the prewar level was recovered in 1960-61. In Africa, in contrast, per caput food production, which was some 6 percent above the prewar level in 1954-55, appears to be now fractionally less than before the war.

In Latin America, where the population is rising by 2.5 percent per annum, which is faster than in any other region, the prewar level which was attained in 1956-59 has now fallen back to as much as 5 percent less than before the war. In the Near East, too, the situation has deteriorated recently, though there still appears to be a large margin over the prewar level.

In the economically more developed regions, per caput food production has risen to well above the prewar level in each, except Oceania, where the population is growing very fast and production has fluctuated somewhat widely from year to year. In Western Europe, per caput food production has increased considerably in the last four seasons, but in North America production per caput has leveled off, reflecting attempts to prevent further accumulation of surplus stocks in the United States.

Recent progress in eastern Europe and the U.S.S.R. has been slower than in most of the eastern countries.

Greece, Italy, Spain, and Yugoslavia are in the economically more backward southern part of the region. In the less-well-developed regions of the world there has been a particularly rapid movement in Brazil, the United Arab Republic (Egyptian region), the Federation of Malaya, Iran, Israel, Japan, and Mexico. In each of these countries the population growth has been particularly rapid, so that the progress achieved per caput production has meant a very high rate of expansion of total production.

At the other end of the scale, per caput food production appears to have declined over the period 1952-53 to 1959-60 in Sweden and in four Latin American countries (Guatemala, Honduras, Peru, and Uruguay). In the first, Guatemala,

Honduras, and Peru, population has been rising rapidly.

Food Supplies Improved But Still Inadequate

Although food supplies have improved in the worse fed parts of the world, they are consequently lagging still further behind the levels in the better fed areas. It is noteworthy, says an FAO report (1961c), that the improvement in the less developed regions has been entirely in crop products. In the more developed groups, on the other hand, it is livestock products that have increased, and rising incomes have brought a shift from such commodities as grain toward an increased consumption of livestock products and other more expensive foods. In most of the less developed countries, however, the statistics of livestock production are particularly suspect.

Data on food supplies available for human consumption and their calorie and protein content in those less developed countries for which food balance sheets can be calculated show that increased consumption of carbohydrates has brought slightly higher intakes of calories, but intakes of protein, and especially animal protein, remain stationary or have even declined. But in a number of Latin American countries a significant decrease in the consumption of meat can be observed in relation to the early postwar years. (Exceptions include Mexico and Venezuela, where meat consumption has increased.) In the Far East, also, the consumption of animal products has decreased in several countries. In Japan and Taiwan, however, animal protein intakes are now double the low levels prevailing in 1948-50, and still show a steady upward trend.

There is, too, an upward trend in fish production, the outstanding feature being the spectacular advance in fishmeal production in Peru. It has become the world's largest producer of fishmeal. Among other major producers, only South Africa, Japan, Spain, and Chile increased production in 1960.

The safety and suitability of protein-rich foods need study and, on occasions, special investigation. Emphasis by the Protein Advisory Group, now a joint WHO/FAO/UNICEF body, is on food mixtures based on groundnut, cottonseed flour, and fish flour. Considerable progress was made by the FAO Conference on Fish in Nutrition held here in Washington in the fall of last year.

Protein-Rich Foods Needed

FAO are also paying attention to soya bean preparations, sesame, meat powder, and certain fermented products. Where milk is not available for children of weaning or postweaning age, there exists a need for safe, nutritious, and cheap protein-rich foods. Fish flour has been developed successfully in Morocco, a soya preparation in Indonesia, groundnut flour in Senegal and Brazil,

groundnut flour, chickpea flour and sesame in India, cottonseed mixtures in Egypt, Sudan, and Central America. Problems relating to milk conservation are also being studied.

In considering protein-rich supplements, both for man and his livestock, some caution must be exercised, particularly in checking that there are no toxic contaminants such as those reported recently in the United Kingdom, where infection of certain groundnut batches with *Aspergillus flavus* var. Link Fries have resulted in the development of a toxic substance or substances which seriously affect health of many farm animals, birds in particular. *Aspergillus flavus* var. Link Fries has been found in many other vegetable products.

Food-production targets, both short and long term, are needed. There is a need for study of patterns and levels of food consumption on a world, regional, and national basis, including variations among different socioeconomic sections of populations, in the light of their specific nutritional needs for calories, proteins, and other essential nutrients. Tables of amino acid composition and also of fatty acid content are needed.

Even in those countries still stricken by malnutrition, the best use is not made of present supplies. This applies particularly to animal protein-rich foods, because habits and taboos prevent their consumption by mothers and children who most need them.

Stumbling Blocks; Lines of Action

Manpower

The quantity and efficiency of the manpower in underdeveloped countries are often poor by reason of lack of health and education services, by reason of social barriers, sheer laziness, and lack of incentive.

In general a high food output per acre is positively correlated with a high degree of industrialization, including power resources and high industry dependence for fertilizers and technical chemicals. Japan is an exception in having half its manpower on the land, yet industrialized and with very high food yields per acre.

Capital

Capital is very short in undeveloped, food-deficit areas. With today's technology, it is difficult to form capital from purely agricultural resources. Somehow these peoples must acquire initial stocks of industrial plant and goods such as fertilizers. Exploitation of their natural resources is necessary to pay for these.

Available Land

About 30 percent of the earth's land surface is "potentially cultivable." This comprises the 9 to 10 percent of the total land surface that is already in arable cultivation and the unexploited balance which includes vast areas of equatorial forests and tropical savanna and grassland (Stamp, 1961). These grasslands fade off insensibly into the forest

and waste, and further expansion is possible: they can also be converted into arable land, especially after defects have been corrected. The extensions of the cultivated land, however, are outstripped by the increase in population so that the area per head in the world is falling.

Asia, with only two-thirds of an acre of arable land per head, stands lowest. At the other end stand North America and Oceania, with 2½ and 4½ acres per head, respectively. These produce an ample diet for themselves and a surplus for export. Africa, with nearly as much land per head as North America, also exports plant products, including vegetable oils for margarine, but not grain nor animal products; its people probably suffer more from malnutrition than from hunger. Europe would appear to present the key to the whole problem; it has less than 1 acre of land per head, but its people, notably in northwestern Europe, have completely revolutionized their systems of agriculture. But these improvements and transformations cannot be simply applied to the agriculture of the hungry countries for in all, except the Communist countries, food production is essentially a one-man enterprise, except for plantation crops such as tea and coffee.

In most countries the picture is of food production by peasants with little or no formal education, but often native shrewdness, with only small holdings producing for their own use and sending their surpluses to market. Their systems are usually self-contained, and their appliances can be made and maintained by the village craftsman. As Sir John Russell (1962) has pointed out, they know that their methods produce food and are naturally loath to change them. The lesson of the British groundnut scheme in Africa is not to thrust undiluted western techniques of mechanization on primitive small holdings, but rather, help them in evolving new and simple tools appropriate to the situation in which they will be used. The National Institute for Agricultural Engineering of the United Kingdom has designed animal-drawn tool-bar equipment for use in tropical agriculture. This aims to provide more efficient utilization of animal power, so that productivity and the general agriculture can be raised and costs reduced. The other idea behind the design was to provide a simple means for a breakaway from traditional methods of cultivation, planting, weeding, etc., and at the same time to serve as an educational medium to help the native farmer to become toolminded and thus, in the fullness of time, ready for full mechanization.

Fertilizers

One of the easiest innovations is the use of fertilizers. Most crops are starved of the essential elements N, P, and K. At no trouble to the cultivator except to hoe them in, increases of the order of 25 to 50 percent or more have been achieved in Asia and Africa. But they are costly and they have to be transported some thousands

of miles. They must therefore be used skillfully. Properly conducted field experiments supported by soil surveys and soil analyses can alone give the agricultural advisers the necessary basic information.

The world's deposits of phosphate and potash will suffice for a long time to come, and supplies of nitrogen, fixed from the air, are unlimited. The fixation of nitrogen still ranks as one of the most unexploited chemical discoveries of all time. Thus Japan, by applying fertilizer nitrogen at a rate of about 100 pounds to the acre, and by concomitant improvements in agricultural practices, achieves average yields from her paddy (rice in the husk) fields of about 35 hundredweight per acre where as India, applying only 1 pound per acre, obtains little more than a quarter of this yield, yet local Indian yields have been multiplied two-fold or threefold on experimental farms.

Food deficits have most frequently to be made good with protein as well as carbohydrate, but, as the efficiency of conversion of fertilizer nitrogen to animal protein is low, this adds to the amount of nitrogen required to provide for man's requirement.

For the world as a whole, estimates of fertilizer nitrogen likely to be needed by the end of the present century range from over 30 to nearly 60 million tons a year. For this, formidable but not impossible quantities of energy will be required (Richardson, 1960). Some vast hydroelectric schemes like the Bhakra-Nangal project in India should be capable of producing energy on the scale demanded. Although it will be a decade or two before nuclear power makes an appreciable contribution in Asia, its long-term significance to a country like India, with plentiful supplies of thorium, is immense. In places where natural gas is now wasted, like the Middle East and Venezuela, it could be collected and made into several million tons of fertilizer nitrogen. Pawley (1954) has estimated that fertilizers, manures (dung), and legumes could double food production in large parts of the world.

Richardson (1960) has stated that the direct response to fertilizers used at moderate rates in underdeveloped countries has varied around 50 percent and that this figure should be doubled in order to take into account the effects of the other agricultural improvements which will inevitably be introduced along with fertilizers. This conclusion has been drawn from the changes in crop yields, but has come about as countries beginning with primitive agricultural systems have improved them first by better farming systems and organic manures, and subsequently by introducing modern agriculture fertilizers. In such countries the primitive yields have been at least doubled by farming improvements of the traditional sort, and then doubled again by modern scientific methods, about half of the latter increase being due to the use of fertilizers.

A fourfold crop may seem too much to expect for a country like India that has a scanty and irregular rainfall in certain areas, yet a threefold increase in cereal yields could be attained. In India this would amount in average yields of around 2,000 pounds of wheat and 3,400 pounds of paddy rice per acre, which are well below the rates obtained in more advanced lands.

The greatest need is for adequate advisory or extension services and this means something more than one such officer in the field for every thousand farmers (Slater, 1958).

Experience in Australia and in New Zealand has shown that the carrying capacity for livestock of natural grasslands can often be multiplied several times by correcting trace-element deficiencies and using chemical fertilizers and improved herbage species. In most countries the productivity of the soil for human-food crops is also greatly increased by adopting rotations that include livestock and fodder crops or temporary leys.

Farmyard or kraal manure is very effective as a fertilizer, but, unfortunately, in great areas of Indian and Central Africa it has to be dried and used as a fuel for the cooking stove because of the shortage of wood. Some 225 million tons of cow dung are burnt in India as fuel annually. Some alternative, but equally suitable, fuel is needed, which would suit the methods of low-temperature cooking which the women have evolved.

Water

Water is the main limiting factor in large parts of the world. Only 11 percent of the world's cultivated areas are irrigated, but this could be raised cheaply to 14 percent if capital were available or, more expensively, to 20 percent (Brown, Bonner, and Weir, 1957). There is a long-term potential source from the desalting of sea water and brackish underground water. The effective use of water creates consequential need of plant nutrients; e.g., as fertilizers.

Water Goes Uselessly to the Sea

With India's long experience, only about 14 percent of its arable land is irrigated, and not more than about 7 percent of the water flowing in the rivers is utilized; the rest goes uselessly to the sea, sometimes doing much damage as it goes. Irrigation is practicable only where the whole terrain is suitable, and that happens only in a few places. It is for this reason that only two of Africa's river systems can be used, the Nile and the Niger, and then only in a few districts. The Orange River and the Tana are disappointing. Even Japan and the advanced countries of western Europe are finding that the natural rainfall is no longer adequate. There is a great need for a more efficient electric pump, which will take water from a deep tube well and supply several hundred acres of land (Russell, 1962). In certain parts of Pakistan such equipment is badly

needed also for land drainage and reclamation, where rise of the water table has brought salt to the surface. Large-scale canal irrigation, unless properly controlled, may increase the water-logging. There is great scope for dam construction. The problem of making the most efficient use of a limited supply of water seems to be one of great importance and demanding more facilities for its investigation.

The arid regions which are devoid of irrigation possibilities are generally those of greatest poverty. In these circumstances the methods adopted include the use of drought-resistant varieties of crops and special methods of soil cultivation designed to increase the capacity of the soil to accept and retain as much as possible of the sparse and erratic rainfall and to protect the water so retained against loss by evaporation and drainage (Landsbury, 1962). A mulch of dead vegetation and the buildup of soil particles into crumbs, thereby increasing the pore spaces and interstices, will tend to hold the water against the pull of gravity. Good cultivators are very skillful in bringing about crumb formation, but the methods are entirely empirical, and science, though unable to explain how crumb formation takes place, has produced substances that bring it about. At present they are too costly to use—but so were plant nutrients when first discovered. Russell (1962) has pointed out that no soil problems are in greater need of solution than those concerned with this process and with the stability of the crumb after they are formed. Such areas also need protection against high wind and storm wash.

Crop Improvement

Keeping to the theme of minimum disturbance of the cultivator's routine pending his improved education, another effective means of increasing production is by the use of better and more productive varieties of crops. Much better results can be obtained by selecting and growing the more responsive sorts obtained by modern methods of plant breeding. Among the desirable qualities that can be carried into the new varieties are resistance to drought, to disease, to attack by pests; nutritive value also can be increased. Notable successes have been achieved in India and Pakistan with sugar, wheat, rice, leguminous and other food crops, and in the semiarid regions of peninsular India with drought-resisting sorghums. Higher yielding varieties of sorghum are promised in east Africa. We note in passing the virus-resistant varieties of cassava and rust-resistant varieties of maize. This is the safest way of dealing with insect pests where it is practicable; it is much preferable to the use of potent chemicals used as sprays in advanced countries. But adequate support is needed for this objective basic research. Such selection takes time, sometimes 12 years, before adequate supplies of seed are available. In the absence of resistant varieties and for the destruction of food by disease, insects, weeds, or vermin

we need the chemical substances produced by industry.

According to E. W. Russell (private communication) there is little value in introducing varieties of crops with a higher potential yield until the whole system of agriculture is improved, but the introduction of varieties of crops resistant to important local diseases is always worthwhile. It is always much better to breed crops resistant to important local diseases. It is always much better to breed crops which will store well under village conditions.

Avoidance of waste is often simply a matter of building a road, but faulty handling and marketing add their quota to infestation and decay. It has been estimated that between one-third and one-half of all fruit and vegetables harvested in India may be lost in this way.

A new variety of wheat may require 30 trials spread over 3 seasons at a wide range of centers before it can be recommended. The diseases which are considered important in our country are those for which there is no easy control except through the use of resistant varieties.

Plant breeders in various countries are developing mildew-resistant varieties of barley, oats, and wheat.

Cereal yields per acre have increased greatly; in the case of wheat and barley, by some 40 percent in the last 20 years. To this end, of course, other factors such as fertilizers and chemical weed control, better seed dressings, and combine harvesters have contributed.

Coconuts, which are perhaps basically the most important plantation crop as food, are, tragically, the most inadequately served of all the tree crops, and by research we need to know how to reduce the often catastrophic effects of virus infection. Other plantation topics which need research are the control of diseases and pests by chemicals, the probable importance of phages in the etiology of bacterial diseases, the use of cuttings on the grand scale as a technique for rapid multiplication of the best varieties, advancement in the control of scion productivity, and behavior by improvements in rootstocks. Storage investigations enabling shipment and orderly marketing of vast quantities of fresh food are also needed.

Technical chemicals

Broadly, their use follows the pattern of fertilizer use per acre per man. The potential and actual supply in a given country depend primarily on the rate of industrialization or economic development through buildup of external purchasing power via suitable exports; e.g., Denmark, New Zealand, and Ghana. In the last-named country the control of the cocoa aspid is a good example (Holmes, 1960).

The losses caused by weeds on farms in the United States equal the combined losses from insects and diseases and are second only to farm losses caused by soil erosion (USDA, 1954). They

compete with crops for water, light, and mineral nutrients, and increase the cost of labor and equipment. They are among the most formidable obstacles to completely mechanizing crop production.

Farm machinery and mechanization

Broadly, these are related to the factors influencing expansion of the use of fertilizers and technical chemicals. Hovercraft may have great possibilities for difficult terrain. Recent new ideas in machinery for lesser developed countries are: (1) Small rice thresher (this has been successfully developed); (2) ox-drawn tool bar already mentioned; (3) jigs have been designed to allow local mass-production of oxcarts.

Power and public utilities and ancillary agricultural industries

These are largely dependent on economic development rather than on industrialization.

Animal production

We cannot reap the harvest of our preventive medicine if water or fodder is insufficient to maintain life and production. It is, as Stableforth (1961) has pointed out, equally frustrating to improve fodder supplies, and potential production of meat, milk, eggs, wool, if the effort is to be crippled by sudden or insidious inroads of disease. In all our efforts to improve living conditions, it is self-evident that those concerned with water, soil, crop production, plant and animal genetic potential, and with disease, must work side by side, and also with those concerned with human health. It is obvious that with the advances against famine and pestilence the increased number of survivors can produce extra food. Control of enzootic and epizootic diseases such as trypanosomiasis, rinderpest, foot-and-mouth, parasitic diseases, anaerobic diseases, to say nothing of tuberculosis, brucellosis, and mastitis, is necessary. The extension of international organizations concerned in work of this kind is to be encouraged. What has been demonstrated so clearly in rinderpest control in several areas of the world, and in foot-and-mouth control in Europe (a disease which costs nearly £150 million) may become the policy of every nation.

It has been estimated that to feed the world population expected by 1980—viz: about $4,000 \times 10^6$ —at a reasonably improved level, it will be necessary to increase the world's production of milk, meat, eggs, and fish by 100 percent; for the year 2000, animal protein will need to be increased by 300 percent. Since only some 7 percent of the world's production changes hands from one country to another it is equally certain that these increases must in the main be achieved in the countries where the shortages exist; first, because surpluses in other countries are usually small in proportion to total needs; secondly, because they would be beyond the means of the needy country to purchase and would be difficult to transport; and, thirdly, because they are often of a different

kind (e.g., grain or meat) which is unacceptable to the people needing them.

In a hungry world it is also galling to think of the amount of food wasted through lack of proper storage and processing. It has been said that in Africa one man out of every three works for pests.

Underdeveloped countries have particular problems in applying modern food technology to local conditions. The improvement of traditional food-processing methods such as drying, smoking, salting, pickling, and fermentation or the production of indigenous foods in countries having low economic status is of importance, particularly if developed along scientific lines, and low-cost processing units of simple design should be developed for this purpose.

The time is probably coming when milk will be produced in much larger quantities than at present in countries where conditions are particularly favorable for its production, as in New Zealand, and it will be dried on a large scale and consumed in other countries where milk production is not a suitable form of agriculture. Modern scientific knowledge applied to the drying and packing processes should make this sort of thing more feasible than it has been in the past.

We must, however, guard against ill-considered applications of newer developments until thoroughly explored as feasible; e.g., radiation sterilization and accelerated freeze-drying.

There has been a failure of animal production to keep pace with production of food crops in developing countries, and inadequate nutrition is singled out as the main factor (Shaw, 1962). Better grassland and forage management can contribute more food and, in developed areas, cheaper food.

The Tropics in the pastoral sense lie between 30° N. and 30° S. of the equator (Davies, 1960). The land area of the world appears to be about equally divided between the tropics as defined above and the remainder. Only about one-fourth of it is used for arable and pastoral agriculture. The proportion of the total value of the crops or products are: 30 percent for grains; 20 percent for plantation crops; and 40 percent for animal products.

Stocking and grazing control may treble the production without attempts to improve directly soil fertility (Wannop, 1962).

In the tropical rain forest areas, introduction of modern grassland husbandry practice could result in an increase in the total area available for food production; a replacement of some at least of the area devoted to bush fallow and with good livestock management a valuable increase in the supplies of animal protein byproducts in these areas for pig and poultry production. Green silage can take the place of concentrates for dairy cattle.

In the arid Tropics, including dry forest areas, steppes, savannas, and scrub forests, the standing hay and browse (fallen leaves, etc.) have a low

nutrient content, with dry matter amounting to 93 percent with crude protein about 2 to 4 percent, yet this may be important as in Australia.

Adaptable Pasture Legumes Needed

In other areas, enhancement of animal production will also largely depend on increased production of cereal grains and legumes. The need for accelerating research on establishing new varieties of pasture legumes which can survive in the tropics and subtropics not only for wet areas, but more particularly for the arid areas, has been stressed (FAO, 1961b). Much more basic research is needed if agents such as urea and other sources of non-protein nitrogen are to be used most effectively as the nature of the rest of the ration plays an all-important part in the efficient utilization of nitrogen sources:

Tribe and Coombe (1962) have reported that spraying standing poor-quality grass with urea solution has increased the carrying capacity of some of the very dry areas from one sheep per 5 acres up to five sheep per acre. Molasses are probably also needed as a readily available source of energy for the rumen micro-organisms. This may help to keep the sheep alive until the rains come. Urea blocks are also being tried out in Australia.

More information is needed in developing countries on the crude protein and amino acid contents of locally available feeds and byproducts. This would facilitate pig and poultry productions, as these can be promoted locally and with low capital investment.

There is a need to preserve the vitamin content of available natural sources but, undoubtedly, synthetic vitamins which are relatively cheap and can be protected may play a useful role in rations for livestock. The fat soluble vitamins which are liable to destruction through oxidation are A and E and here stabilized forms offer a more certain advantage than do antioxidants.

It was generally recognized that the use of antibiotics had positive effects on the growth of pigs and poultry where these agents were being used in a new area, but that the effect was much less apparent later and particularly under good management conditions. With continued use the difference between nontreated and treated became less significant. In many countries supplements of copper sulfate has increased the rate of growth of pigs, but before it is used in countries where the mineral content of the rations is unknown appropriate analysis for copper levels and trials should be carried out.

The use of the "linear programme" approach to the formulation of economically efficient poultry feeds in developing countries helps more accurate rations to be formulated and more economical and efficient use to be made of the available and potentially available feedstuffs. It also demonstrates the need of movement of critically important in-

gredients into those countries where such ingredients permit more efficient use of locally available supplies. A secondary result is that it permits more rapid progress in breeding and management through the use of demonstrated trials involving improved feeds (FAO, 1961a).

The importance of animals adapted to rigorous conditions cannot be overemphasized as, apart from better water supplies, it is difficult at first to improve existing conditions. *Bos indicus* is better suited than *Bos taurus*, and the camel and some wild game animals are even better adapted and could be exploited to produce more meat. No serious study has been made of the use of drought-evading trees, the forage of which would be suitable for animals. But the greatest contribution which some countries could make would be to bring down their livestock numbers.

Increasingly, mineral deficiencies and imbalances are being found where they were not known or suspected before. Good methods are available for mineral analyses in well-equipped laboratories, but many of these are not practical in remote areas where the deficiencies occur. There is a need for simpler methods for quick field analyses (FAO, 1961a).

While there is need for a simplified handbook summarizing the means of identifying deficiency states, it should be noted that many animals show signs of an indeterminate condition of ill thrift. Mineral analyses or feeding trials are necessary to identify these conditions.

Introduction of the knowledge of the most suitable time to "reap and harvest" from animals, eg. correct age to kill, etc., has been pointed out to me by W. J. A. Payne as a necessary item in the education of the native East-African farmer.

Fish in Nutrition

According to the findings of the FAO International Conference on Fish in Nutrition held in Washington from September 19 to 27, 1961, it is not too difficult to believe that the oceans can supply at least twice the protein yield now achieved on land as the oceans cover more than twice the area occupied by land on the surface of the earth. By fertilization or forced upwelling, man may substantially increase the yield of fish. Because raw (unprocessed) fish is highly perishable, and because in most parts of the world there are limitations in transportation facilities, the use of fish for direct human consumption is limited to areas adjacent to the shores of the oceans, lakes, and rivers. Methods of preservation for human consumption range from simple salt curing or drying, canning, and freezing to the production of fish protein concentrate (fish flour). The basic scientific information into the chemistry, biochemistry, physics and biophysics, and bacteriology is probably best left to the higher developed countries and the technological investigations necessary to put into effect existing knowledge in the local

situation must be assisted. Improvement of traditional methods should be explored. Studies are needed on the possibility of improving the storage life and variety of fish sausages. In another context, the incorporation of different plant protein concentrates into a sausage was advocated by my late colleague John Duckworth for Central America and is being used to some extent.

The search for reliable objective indices of product quality—in respect particularly of protein—is being pursued, but probably should be intensified.

Much remains to be done in developing improved procedures, plants, equipment for treatment of fish at sea or on shore, and the processing, storage, transport, and distribution of fishery products of various types (chilled, frozen, smoked, canned, dehydrated, etc.).

With special reference to the needs of developing countries for more high-grade protein, the production of cheap and acceptable deodorized or nondeodorized fish flours or protein concentrates suitable to local tastes and requirements can fill a gap, but there is a requirement for standards of nutritive and keeping quality.

In the developing countries the first requisite is to increase fish consumption, because in many cases this is potentially the cheapest and most easily available source of animal protein.

Increased consumption of fish and fish products is desirable particularly in high-cereal diets, since fish proteins have a definite supplementary nutritional value, being rich in lysine and methionine. In addition to the high quality of proteins, fish and fish products provide poly-unsaturated fatty acids which appear to keep down the level of cholesterol and other blood lipids. The effect of tocopherols, other antioxidants, and also all other dietary components should also be studied.

The introduction of a new product such as fish flour, whether it be produced locally or imported, calls for extensive experimental engineering. Such a product must be cheap and enjoy common acceptance.

In addition to the local use of fish for human consumption, fish and fish products—especially fishmeal—also play an important role in the nutrition of farm animals, supplying unusually high amounts of the critical amino acids, lysine and methionine, and is rich in minerals and vitamins. Animals can utilize fishmeals otherwise unacceptable to man. Older ruminants can utilize efficiently fishmeals which have been so damaged as to render them unsuitable for humans, pigs, and poultry and young ruminants.

Improved Use of Primary (Plant) Production

This can be achieved in various ways.

Reduction of pests and diseases

Reduction of pests and diseases on farms and in stores depends on genetic research, but also on

technical chemicals and on improved inputs. The losses through insect infestation are enormous. Up to 30 percent of certain staple foodstuffs may be lost in the course of a year. The damage to stored products resulting from insects is vastly greater in the Tropics than in temperate climates. Research in this field, supported by industrial development, is constantly producing new ideas or improvements; for example:

- (1) Use of airtight storage for famine reserves. The insects are killed by depletion of the oxygen which they themselves have consumed. At not more than 13 percent moisture content grain harvests will keep for years. Large numbers of airtight pits have been constructed in a number of South American countries and provide safe storage of some millions of tons of grain.
- (2) Plastic containers prevent cross-infections.
- (3) Fumigation and spraying techniques, insect repellants, and proper construction of food stores all play their part. Entire pyramids of grain have been fumigated successfully with methyl bromide applied under enormous gunproof sheets against the beetle *Trogoderma granarium*.

In efforts to control insect pests of growing crops, much good can often be done by modifying agricultural practices; for example, by advancing or retarding the time of sowing the seed, by deep ploughing to destroy resting larvae or pupae, by burning trash, and so on; and highly toxic insecticides can often be used on growing crops, provided sufficient time is allowed for their detoxification or removed by rain before the crop is harvested. For obvious reasons the only pesticides that can be used on a harvested crop in store are those which will not taint or poison the foodstuff.

Control of use of livestock

Generally, this may be necessary or obvious in order to shorten, or at least improve, the efficiency of the food chain. Excess livestock in some developed countries are often due to social and religious customs (e.g., Africa, India, and parts of the Middle East). These are some of the most intractable social problems. Their continuance leads to increased production of wretched animals with very little milk which devastate pastures and invade crops.

Within strict limits, livestock policy can be adjusted so as to reduce competition for grains and other low-fiber foods edible by humans, but for enhancing animal protein in the dry Tropics grains are more easily produced than pastures. By encouraging the more efficient converters among livestock of fiber into human calories and protein via animals, food capable of being used directly by man be saved for his use. The lactation type of animal is a more efficient converter than the meat-producing animal. The general trend is for increased economic circumstances to be coupled with increased consumption of animal protein. Live-

stock used for draught purposes can be replaced by tractors, plus wind and sun power for pumping water.

Plant-growth substances

The discovery and proper use of plant-growth substances (including selective weed control) represents one of the biggest developments in scientific agriculture over the past 25 years. By far the greatest use of growth substances has been in protecting crops from weed infestations. Fundamental investigations on the relationship between chemical structure and growth-regulating activity help us to understand their mode of action, and often lead to the discovery of new active chemicals. Good farm management with rotations, surface cultivations, and fertilizer treatment to secure an adequate crop in conjunction with chemical weed control is the best means of keeping land clean.

Growth substances are also used for rooting cuttings and for preventing "preharvest" drop. Hormone inhibitors develop during normal growth and may be of importance in dormancy.

The finding that a plant's resistance to disease may be due to the presence of specific, naturally occurring chemicals within its tissues provides another line of approach to systemic fungicides.

Preservation of fresh fruits and vegetables

Probably the main developments have been in:

- (1) Better use of temperature; selection of most suitable temperature; more uniform conditions in cold stores; rapid cooling by various forms of precooling, e.g., blast cooling, hydrocooling, vacuum cooling; improvements in refrigerated and insulated transport.
- (2) Restricted ventilation so as to push up CO₂ and reduce O₂.
- (3) Specific prestorage treatments to reduce physiological diseases, e.g., use of wraps impregnated with diphenyl is now permitted throughout the world to reduce rotting of citrus fruits.

Biochemical methods

Many millions of tons of cellulose and lignin are wasted each year. These could be used if hydrolyzed, and for such developments money could theoretically be provided by the World Bank, FAO, etc.

Pirie is probably the chief exponent of what may be termed the general biochemical approach to malnutrition through compensating deficiencies in plant foods by supplementation with the missing nutrients obtained by separation from other plant material—possibly waste materials. The two largest potential sources of new plant protein are leaves and the residues of oilseeds. The latter, if properly conserved and distributed, could satisfy about one-third of the world's protein needs. They have been neglected hitherto because of preoccupation with the oil and because of the technical difficulty of processing the seeds in such

a way that their protein retains its palatability and feeding value. The difficulties are largely being overcome and studies of oilseed residues in human food are gaining an important place in programs of the international organizations responsible for world food supplies.

Leaf protein is still largely neglected, but its nutritive value has been amply demonstrated (Pirie, 1960). The world's needs are vast, and oilcake, fishmeal, leaf protein, soya, yeast, and other things will be needed.

Education, Research, and Extension

Education, research, and extension in the agricultural services all hinge on education, which in turn depends on the rate of economic development and industrialization. So often the exclamation is: "We know what should be done, but we cannot get it done."

Education is essential for industrialization, economic development, and agricultural improvement, and to reduce social inertia and remove social barriers, and, lastly, for effective population-control policies. How to break the vicious cycle, how to break through the custom, social, and economic inertia of a purely agrarian society, to acquire capital and get the economy on an accelerating industrial basis, is the problem. This has been described as the "takeoff" problem.

Since the last war, the developing countries have been making serious efforts to establish, organize, strengthen, and improve their agricultural extension, research, and education services with the object of accelerating their agricultural development.

The degree of expansion of these services depends to a considerable extent on the nature and volume of resources devoted to them by governments. Since 1945, funds, scientists, technicians, equipment, and supplies have been made increasingly available by the developing countries.

Unfortunately, in many developing countries, the ministry of agriculture receives a relatively much lower volume of financial resources than other ministries, despite the fact that agriculture is the most important segment of the national economy. Agricultural extension, likewise, receives a relatively lower proportion of the agricultural budget than agricultural research and agricultural education institutions.

Most of the budget for extension is spent on salaries, with the salaries of headquarters personnel utilizing an unreasonably high proportion of the total.

To obtain maximum results, extension should be concentrated on education as opposed to regulation and assistance, and focused sharply on satisfaction of the farmers' needs.

The major obstacles to progress appear to be lack of funds, of trained staff, and of a clear workable organizational structure which makes it possible for decisions taken by the policymakers to

be carried out efficiently. In the training of staff, greater emphasis might with advantage be placed on extension methods, technical subjects, and practical experience.

Higher priority should be given to fieldwork. Cooperation between extension and research education, credit, marketing, and other services could generally be improved.

Research

Money and trained staff are in short supply. There is need for a sufficiently clear order of priority between projects and in fixing priorities in respect of farmers' needs. FAO (1961c), in its review, finds that there is a tendency to neglect such subjects as agricultural economics, including farm management, agriculture extension, and rural sociology. Greater emphasis should be placed on applied research and particularly in the field of tropical research. Equipment and supplies need improvement. Trained teachers are in short supply and are not usually given a chance to engage in research as well as teaching. Funds frequently do not permit both. Courses are often not sufficiently realistic, particularly in economics, farm management, agricultural extension, and rural sociology. The training farms are not always well managed or in line with local enterprises.

Later in their development more money can be devoted to objective basic research which should not be too closely controlled by the economists; otherwise, scientific freedom may be curtailed and further advances stifled.

As an example of the kind of research referred to as objective basic research we might take the research going on to discover the biological secrets of the high-yield paddy fields where yields of around 11,000 pounds of paddy per acre are found. It is not fantastic to expect the Japanese to double their already high average.

In the application of scientific knowledge one of the principal difficulties facing the developing countries is the lack of trained personnel. In the case of animal husbandry the traditional veterinary training has not provided the practitioner with the necessary background for research and development in animal science. The same applies to the animal-science training by agronomy groups. The fundamental training in biochemistry, physiology, microbiology, physics, and advanced biology now required of undergraduates in animal sciences shows clearly the orientation which is occurring in the training. The lack of students from agriculture who are adequately trained to go into basic research is becoming increasingly apparent.

A special type of well-trained specialist is required for the developing countries if a shortcut is to be made. He must be grounded in the fundamentals but nevertheless conversant with the practical problems of production awaiting solution. The relationship between the veterinarian, the

animal husbandman, and the agronomist and their training probably requires some reevaluation in many parts of the world.

There is a pressing need for a corps of general practitioners in animal production, and this will also hold for agronomy and soils. There is a need for a few centers in the various developing countries where basic research on local problems can be investigated and where advanced training can be given. The formation of crop and animal production societies should be encouraged and should be integrated with nutrition societies.

Malthus believed that the only way out of the dilemma of man's increase in population outstripping his increase in production of food lay in the application of science to the problem; so we, in our day and generation, believe that the dilemma can meantime be resolved by the application of existing knowledge and by planning investigations for the decades that lie ahead.

Abstracts and Information Services

The Commonwealth countries through the Commonwealth Bureaux of Agriculture Executive Council provide an abstract and information service to the scientist on all aspects of agriculture and forestry except perhaps economics, machinery, and implements. FAO provides an abstract service for fisheries. But food science and technology is only partially dealt with, and it is in this area that there is urgent need for the setting up of an additional abstracting and information service. At the Rowett Research Institute in Aberdeen there is located the Commonwealth Bureau of Animal Nutrition which also deals with man himself, and in this bureau there has been set up a system of classification of all the literature on nutrition and with machine retrieval of references to any subject classified within the system. It is generally agreed that it should also be responsible for the machine retrieval of the literature on food science and technology once a bureau to this end has been set up. Various meetings are taking place to this end. These bureaux save individual organizations much labor, but not as yet largely in food science and technology.

Some thought must be given to the setting up of information services in the field of husbandry, and this may have to be done at low levels in some of the developing countries where there is much illiteracy.

In my contribution to "Benjamin Franklin's Unfinished Business" (Cuthbertson, 1956), I wrote somewhat as follows:

If present knowledge were fully exploited, a world population of 6,000 millions could probably be supported; but it is unlikely that such a figure will ever be reached. Modern science has already in part the answer to the problems that worried Malthus; indeed, he did not doubt that an answer would be forthcoming, but some of his successors have.

What is needed is that advances be pressed with vigor and understanding now to save the future.

The anachronism of vast populations leading lives steeped in poverty and ill health in a world where "a thousand secrets of mastering nature, of increasing productivity, of prolonging life, of liquidating want, are practiced and known" can and must be removed by the people themselves through their energy and purpose, technically aided by those who have already profited by such improvements. This can only be secured if there is also an adjustment of mental attitudes toward lasting peace throughout the world with freedom of its peoples from want, disease, and fear. This was the essence of a paper Benjamin Franklin wrote over two centuries ago.

In conclusion, man has at his disposal the means of controlling his destiny on this planet so that he may have a creative and happy life, unmarred by hunger or malnutrition, but to secure this he must also learn to control himself.

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Discussion

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I WAS IMPRESSED by the sweeping panoramic view of the world food situation as related to knowledge of science and its application presented by Dr. Cuthbertson. One hundred and sixty-four years after Malthus, he has raised once more the ever-pertinent question: Can man's agricultural production which tends to be linear in its growth be made exponential to catch up with population growth?

Perhaps the existing level of scientific technology is in the main, as Dr. Cuthbertson proposes, amply sufficient to allow the solution of the world food problem—but mainly in the temperate regions of the world where these research have been developed and applied. In part of the temperate areas of the world the application of scientific research to farming has increased the efficiency of production to the point that the use of the surplus of food has become a major economic problem. There, the population is, on the whole, well fed, healthy, and productive, in contrast with the underdeveloped countries where the quantity and

efficiency of manpower, Dr. Cuthbertson has pointed out, is much lower.

The average per capita income in the rural areas of Latin America is one twenty-fourth of the overall average in the most advanced countries in the world. The income of the farm population in Latin American is one-third of the average income of the urban population. Total current investment in agriculture in Latin America is one-twentieth of the investment in agriculture in the more advanced areas. Within Latin America, the investment in farm enterprises is less than half the investment in manufacturing industries. Although agriculture uses more than half of the human resources in Latin America, it contributes with less than one-fourth of the total value of production. Per capita gross agricultural product has increased only at the rate of 0.8 percent per year in the last decade. The farms over 1,000 hectares (2,471 acres) in size represent only 1.4 percent of the total number of farms but cover 64 percent of the farmland. The farms of less

than 5 hectares (12.4 acres) represent 48 percent of the total number of farms and cover only 1 percent of the total farmland. We are confronted, therefore with an underdeveloped agriculture in an underdeveloped economy that is largely poor, has low capital investment, is inefficient, and has unequal distribution of the land and the income.¹

Let us analyze that situation further to see how science development and its application can help to promote accelerated economic growth and social stability. I will limit my discussion to the corner of the world with which I am somewhat familiar: the Western Hemisphere, the area of competence of the Interamerican Institute of Agricultural Sciences of the Organization of American States. I will confine my remarks largely to tropical America, which is the area of particular interest to our tropical Research and Graduate Education Center at Turrialba, Costa Rica. Although I shall draw freely on the views of my colleagues, I will not hold them responsible for the consequences of my attempt to comment on Dr. Cuthbertson's stimulating paper.²

We at the IAIAS use the word "agriculture" in the broad context of all the factors affecting the production, processing, distribution, and consumption of plants (including the forests) and animals useful to man, including the economic and social aspects of the management of the farm, the household, the farm family, and the rural community. It is in this context that I shall refer to the agricultural situation in tropical Latin America, selecting a few examples from some fields to give an idea of the major progress, trends, and future scientific development.

Food Production³

As Dr. Cuthbertson has pointed out, Latin America has the highest rate of population growth

¹ José Marull. Areas demostrativas de extensión. Rio de Janeiro, ABCAR, 1962 p. 7.

² The author is particularly indebted to the following staff members of the Tropical Research and Graduate Education Center of IAIAS at Turrialba who supplied illustrative material and with whom the ideas for this paper were discussed in a session organized and conducted by Dr. Howard Boroughs, Head of the Nuclear Energy Program, who himself provided information on human nutrition and fisheries: Dr. John V. Bateman (animal nutrition); Dr. Gerardo Budowski (forestry); Dr. Alfredo Carballo (plant genetics); Dr. Robin L. Cuany (forage crop improvement); and Prof. Frederick Hardy (soils). He is grateful also to Dr. Fernando del Rio, of the Department of Economics and Extension at Turrialba, and to Dr. José Marull, Director of the Planning Office, San Jose, for information on extension and economics.

³ Additional data may be found in publications such as the FAO Animal Production Yearbook; the U.S. Department of Agriculture's Annual Agricultural Statistics; publications of the U.N. Economic Commission for Latin America; and various monographs of the Pan American Union. The FAO publication *La creación de nuevas unidades agrícolas*, edited in 1961, contains concise summary tables.

in the world. Seven countries have a rate of more than 3 percent per year; all of them within the tropical belt. It is no wonder that the *per capita* food production is now 5 percent still below the prewar level. It will take a substantial increase in the efficiency of agricultural production to catch up with the demands of population growth.

In 1960, 200 million persons lived in Latin America as compared with 180 million in the United States. Yet, five times as many Latin Americans lived on farms than North Americans. In 14 of the 20 American Republics the rural population was more than 50 percent of the total population.

Only Argentina, Cuba, Chile, Mexico, Uruguay, and Venezuela—that is, the more industrialized countries, with Colombia coming close—have become urbanized to the point that more people lived from occupations other than agriculture. In Haiti as much as 83 percent of the population live in the rural areas. In 1960 there were 4.7 million farms in the United States, compared with 7.5 million farms in Latin America.

Let us compare, for example, the case of the United States and Brazil, the largest Latin American Country. The United States has a land area somewhat smaller than the land area of Brazil, and yet has 10 times as much cropland under cultivation as Brazil and nearly 3 times as much productive pasture land. Although the population of the United States is almost three times that of Brazil, the 12 percent dedicated to agriculture produce an abundant supply of food for the country and large export surpluses in addition to supplying millions of dollars of raw materials for the processing industries. In contrast, the 58 percent of the Brazilian population dedicated to farming do not produce enough to feed the country and supply raw materials to industry. Much of their effort goes into the production of export crops, like coffee and cacao, of which Brazil is a very large world producer.

Behind these figures lies wide difference in productivity and institutional patterns of land-ownership, education, credit, marketing, transportation, use of capital, research, extension, government services, community development, and technological wealth that add up to a pattern of underdevelopment.

In tropical America, the animal proteins are particularly low; some vegetable proteins lack essential amino acids; calorie intake comes largely from carbohydrates. The Nutrition Institute of Central America and Panama (INCAP) has conducted in the last decade intensive studies on the nutritional needs of the population and the nutritive value of the local products. It has developed a low-cost, protein-reinforced vegetable food supplement "Incaparina" that is beginning to be produced in various Central American countries under license and should contribute effectively to a reduction in the nutritional deficiencies of the low-

income population, especially in the critical phases of child growth.

Let us now take a quick look at the possibility of improving food production in tropical Latin America through fish products, meat products, and food crops.

Fisheries

It is estimated that less than 1 percent of human food comes from the oceans that cover 70 percent of the earth's surface: yet fisheries can be greatly expanded in the tropics where the higher temperatures and the greater amount of light give a comparative advantage to fish growth over the temperate zones.

Dr. Cuthbertson has mentioned the spectacular advances in Peru, that has become in a few years the world's largest producer of fish meal. This has been accomplished mainly because of improvements in the technological processes rather than from the application of science. Perhaps the greatest possibilities for improvement are in inland fisheries, where the environment can be controlled. The introduction of fish in ponds, particularly, offers good possibilities. The Ministry of Agriculture and Livestock of Mexico has an active program of inland "Fish Farming."

The efficiency of meat production from fish in relation to area is far greater than from animals. The application of science to the utilization of the products of the sea to supply animal protein deserves much greater attention. At present, only a few marine biology stations are in operation in Latin America, such as the one of the University of Concepcion, in Chile.

Animal Production

Nearly four times as much land in Latin America is dedicated to pastures as to field crops. In 1959, FAO estimated a total of 367,838 million hectares of land in pastures in Latin America. Yet, we still know very little about the tropical grasses and legumes and the management of the pastures and natural grasslands.

At Turrialba and elsewhere, feeding trials are being conducted to utilize local products as forage for cattle: sugarcane tops, banana stems, dried manihot leaves, and so forth. At the Universidad Agraria, in La Molina, Peru, excellent results have been obtained, both from a weight-gain and from an economic-efficiency point of view, using waste subproducts of the cotton and sugarcane industries to fatten in the coastal lowlands cattle raised in the highland sierras where the lack of adequate feed has stunted their growth. Fish meal has been used in the diets of animals and in the processed meats without adverse effects on the flavor.

Although the American tropics are rich in legumes, neither natural nor cultivated pastures contain a significant amount of them. Little is known about establishing desirable legumes in tropical pastures. There is need to search for tropical

legumes that can be grown in pasture mixtures and to improve the management of the pastures, including weed control, controlled burning to dispose of tough herbage, and planting in alternate bands of grass and legume. Some answers are being provided already by the experimental research stations of the National Institute of Agricultural Research (INIA) of Mexico; the Department of Agricultural Research (DIA) of the Ministry of Agriculture of Colombia; the Office of Special Studies of the Ministry of Agriculture of Chile; the National Institute of Agricultural Technology (INTA) of Argentina; research stations in the States of Rio Grande de Sul and São Paulo, and other research centers in Brazil and other Latin American countries.

There is need for more research on the combination of grasses tolerant to shade and leguminous trees in pastures. It appears that the root bacteria are less effective in the tropics than elsewhere, but we do not know why. Maybe some nutrient elements are lacking. Other sources of nitrogen for the soil should be explored.

It is known that the productivity of the milk cow in the tropics is much lower than in the temperate zone. Is it the breed? Or is it the feed? Dr. Jorge de Alba and his colleagues in the Department of Animal Husbandry at Turrialba are looking for solutions to the problem at both ends, and have worked for nearly 10 years in a program to improve, through selection, the Criollo dairy cow brought by the Spaniards to America four centuries ago. The Criollo cow has adapted itself extremely well to the difficult tropical environments and responds well to upgrading, better feeding, and better management. The Ministry of Agriculture and Livestock of Venezuela has a most promising large-scale, Criollo-breeding program. The Department of Animal Husbandry of the Turrialba Center of IAIAS believes a breakthrough will come from feeding—mainly through the use of byproducts and better grasses. The quick, widespread distribution of Pangola grass is a good example of improvement due to plant introduction and agronomic research.

With the tendency to put food more directly into human use, dairying may gradually displace beef in the tropics as elsewhere. The conversion of sun energy to milk more than to beef is just beginning, but is already placing heavy demands on milk cattle research in both the dry and the humid tropical lowlands. Research is needed also in the high plateaus where the imported breeds from the temperate zones do well, but sound factual research information applicable to the local conditions is lacking.

Plant Production

Dr. Cuthbertson has shown how science has improved dramatically the productivity of domesticated plants in the temperate zones. As an example he has given the estimated 60 man-hours

of labor needed to produce 1 hundredweight of grain by African methods, as against 1 or 2 hours on a modern advanced farm. In Europe, he has pointed out, there is less than 1 acre of land per head, agricultural production is ample to satisfy domestic needs and export needs as well.

The tropics, with which my remarks are chiefly concerned, have yet contributed fewer crop plants for use by man than has the Temperate Zone. Search among the extensive, adapted tropical flora is expected to yield some more useful food and industrial crops.

Back in 1943, the Mexican Government and the Rockefeller Foundation initiated a cooperative effort in agricultural improvement. It was extended later to Colombia and Chile. Even though it began with a few basic food crops such as corn, wheat, and beans, it has been extended to cover also sorghum, barley, soybeans, garden crops, forage grasses and legumes, potatoes, oats, rice, and more recently poultry, beef cattle, and dairy cattle. Through a well-conceived, well-planned, and carefully carried out program of research and education, the Rockefeller Foundation has applied agricultural technology to diverse agricultural situations.

One measurable result of this cooperative effort with the local institutions in the host countries has been the fact that Mexico has maintained steadily over the past 10 years an annual increase in agricultural production of 7 percent, when the population was growing at the rapid rate of 3 percent.

Corn yield in the lowlands of Mexico averages 3 to 4 tons per hectare, while in the highlands that have cooler temperatures and longer growing seasons but where improved varieties and improved cultural methods are now used, the yield of corn is around 14 tons per hectare. The improved varieties already developed could double and triple the yield of corn in Central America; yet it is estimated that only about 30 percent of the corn growers have been reached. In Latin America as elsewhere, science and technology have increased substantially the capacity of land to produce plants through improved cultural practices, irrigation, soil conservation, pest and disease control, plant improvement, mechanization, and so forth. Yet greater efficiency of production could be achieved by applying more widely the existing knowledge. Still, there is need for basic research on the physiology and cytology of the plants, the soil-plant-water relationships, the biochemical processes, and other fundamental factors of biological behavior in the tropics.

Land Use

The weathering effects of high temperature and heavy rainfall on ancient earth rocks have made the latosols the most prevalent soils in the tropics. Prof. Frederick Hardy describes them as being very acid soils from which the mineral plant nu-

trients have been washed out almost completely. Their structure, however, is good; they have good aeration and drainage. With the application of fertilizer, their productivity increases quickly. Yet, research has yielded very little information as to the most adequate management of these soils. For example, not enough is known about the relationship between fertilizers and the clay minerals, nor about the biological complex involved.

Where volcanic ash has covered these weathered soils, there has been a marked increase in productivity. The leading coffee-producing mountain farms have capitalized on this advantage. Erosion, however, becomes a major problem in these areas.

There is a close interaction between the forest and the soil in the humid lowland tropics. When the forest is felled to grow crops, the residues dissipate quickly and the infertile latosols refuse to yield cultivated crops to man. Land use in the tropics, therefore, has to be based on the cycle of plant growth to produce profitably and permanently. The five-story rain forest provides shelter and facilitates the reincorporation of the organic residues. The farming systems in the Tropics should be so devised as to cash in on this residue of the wet forest provided by the shelter. Crops grown should be suitable for growth under the prevailing climatic conditions and should have deep roots to extract the nutrients from a large expanse of the infertile soil.

Much more needs to be learned, through research, to utilize the Tropics properly. For example, it is known that the nitrogen increment in the tropical forests is higher than in the temperate zones. But we do not know why. Is it brought in from the air? An answer to this problem would give a clue to better soil management and fertilization in the tropical lowlands.

Trees Grow Fast in Tropics

Forest utilization must be an integral part of land use planning in the tropics. There is a growing realization that trees grow faster in the Tropics than in the temperate areas, and efforts are being made to capitalize on this fact. Less importance is being placed in the exclusive use of only a few of the tree species suitable for cabinetry, and greater emphasis is placed on the use of natural mixed stands for the production of chipboard, pressboard, and other processed construction products.

More attention should be paid to the use of the trees in forests and orchards for the production of food, fruits, and vegetable oils. The *pejibaye* is a good example of a fruit palm rich in nutritive elements that research could domesticate more fully and technology could make economical to grow and process.

Fifteen years ago, only six Latin American countries had a forest service; today, all have one. Fifteen years ago there was only 1 forestry school

in Latin America; today there are 11. Fifteen years ago there were only 200 trained foresters in Latin America (as compared with 22,000 in the United States), half of which were from Mexico. Today, there are about 600 trained foresters (half from countries other than Mexico) and there is immediate need for twice as many. The potential demand, to make full and adequate use of the large forest resources of Latin America, is for 50,000 trained foresters. Dr. Gerardo Budowski, head of the Forestry Department of the Turrialba Center of IAIAS, and his colleagues emphasize that a continuous effort must be made to convince people at all levels that the forest is not something to clear out of the way, but a renewable resource to be developed and used rationally with the help of trained foresters who are not inspectors and guardians but men charged with responsibility for developing the forests.

In forest development, as in everything else touching on agricultural production in Latin America, transportation is a major factor blocking progress. Without solving the transportation problems, little advantage can be taken of scientific research and technological improvement in most of Latin America.

The Institutional Frame

Agricultural development in tropical Latin America must be based on a broad pattern of land use involving the soils and water, the plants, the grasslands, the livestock, the forests, and the climates. It must go much beyond the selection of varieties of crops and breeds of cattle, and the improvement of cultural practices. Paramount attention must be placed on plant protection as well—protection from weeds, from diseases and pests that flourish and develop as luxuriantly as the vegetation used by man to produce food and fiber. It involves better preservation, storage, processing, and marketing. It involves better farm management, better home management, better community life, better local government, better economic integration, better institutional systems. These of course are not requirements unique for Latin America but needed elsewhere in the world to promote agricultural development, as Dr. Cuthbertson has shown.

In Latin America as compared with Western Europe and the United States, we have to start lower, have much further to go, and need to do it quickly. We need a gimmick to achieve a breakthrough in the Tropics. I believe the human factor is the answer. When we train the numbers required of really competent people capable of building strong and efficient institutions of advanced learning, scientific research, and extension education, we will have a key to the solution of the problem.

It was estimated in 1957 by the members of the technical advisory council of ITAS that Latin America had about 16,000 professional agricul-

turists and needed no less than 43,000 to manage adequately the agricultural research, higher education, extension, and rural development services. Until recently, the colleges of agriculture of Latin America were graduating each year only around 2,000 new professional agriculturists and operated at 57 percent of their capacity.⁴ The enrollment, however, is increasing at an accelerated rate with the pressure for quicker agricultural development.

According to a study made by the Brazilian Association of Rural Credit and Welfare (ABCAR), the 12 colleges of agriculture of Brazil had graduated a total of only 7,425 professional agriculturists in nearly a century between the founding of the College of Agriculture of Bahia in 1875 and 1958. Eight agricultural colleges were closed in 1943, when the higher agricultural State and Federal education system was reorganized. There is an immediate need for 3,000 additional agriculturists, and the colleges are graduating only 300 students each year when they have capacity to graduate 1,700.⁵

Land-Grant Institutions Compared

The first college of agriculture in Latin America, the National School of Agriculture of Mexico, was established in 1854. In the following quarter of a century other colleges of agriculture were established in Tucuman and La Plata (Argentina), Bahia and Pelotas (Brazil), Santiago (Chile), and Bogotá (Colombia). Therefore, when the land-grant-colleges system was established in the United States in 1862, Latin America had initiated already a system of higher agricultural education. Today, there are 68 land-grant institutions in the United States and 60 colleges of agriculture in Latin America as compared with 45 in 1955. But the 68 land-grant universities in the United States are large, multimillion dollar institutions with an enrollment in 1958 of 585,278 students, a full-time staff of 98,243 professors, research scientists, and extension agents, a current expenditure of \$1.4 billion a year, and plant assets valued at \$3.2 billion.⁶ Twenty-five of the colleges of agriculture operating in Latin America in 1955 had an enrollment of only 3,519 students and a faculty of 832 professors, many of whom worked part-time only. In 1960, the combined teaching staff of 46 institutions of higher agricultural education in Latin America numbered 1,497, professors.⁷

⁴ Chaparro, Alvaro. Un estudio de la educación Agrícola Universitaria en América Latina. FAO—Estudios Agropecuarios No. 48, 1959. 208 p.

⁵ J. Pinto Lima; Lincoln M. Rodríguez; Thiago Ferreira Da Cunha; Yonita Assenco Torres. Técnicos para o desenvolvimento de agricultura, Rio de Janeiro, ABCAR, 1961, 402 p.

⁶ American Association of Land-Grant Colleges and State Universities. Centennial fact book. 1962.

⁷ Alberto Franco. Directorio de Decanos y Profesores de los Centros de Enseñanza Agrícola Superior en América Latina. Turrialba, Costa Rica, Instituto Interamericano de Ciencias Agrícolas de la OEA, 1960, p. 124.

In 1960 there were 2,285 extension agents in 19 Latin American countries.⁸

It is estimated that the extension services reach only half a million of the 108 million rural inhabitants in Latin America. Each agricultural extension agent, therefore, would have to reach around 7,000 farmowners. While in the United States, extension education is considered a responsibility of the State universities, in Latin America it is considered a responsibility of the Federal Government itself, mainly in the Ministries of Agriculture.

In 1959 there were in Latin America about 260 agricultural research centers and experimental stations with a research staff of 1,870.⁹ This is very small indeed compared with the huge agricultural research effort carried on in the United States by the cooperative research system of the land-grant universities and the U.S. Department of Agriculture.

That extension education pays when it is properly planned on the basis of farm management studies and properly conducted using sound extension education methods, has been clearly demonstrated in the rural development area operated since 1952 by IAIAS in San Ramon, a subtropical area of Uruguay, in cooperation with the Ministry of Agriculture and other national institutions.¹⁰ In 7 years, the more prosperous San Ramon farms increased their farm income by 31.9 percent and the poorer ones by 64.9 percent. The poorer farms that had adopted the practices recommended by the extension agents had farm income four times higher than the ones not reached by the service directly. The value of total agricultural production in San Ramon increased by 47.26 percent, while it decreased by 11.05 percent in the country as a whole. The rate of economic develop-

ment, measured in terms of gross production per hectare, was 24 times faster in San Ramon than in the neighboring areas. For each peso spent in making the basic studies and conducting the extension program, the value of the agricultural production of the San Ramon farms was increased by 22.83 pesos. The investment in extension education paid high dividends.

Each Country Must Help Itself

I do not believe that knowledge and institutions can be transplanted safely from one culture to another without undergoing a process of adaptation that is usually long, complex, risky, and expensive. In the long run, each country has to train its own people, build its own institutions, and create its own knowledge to achieve accelerated economic development and social stability. But the process can be stimulated by the examples of success and failures elsewhere, and can be sparked by technical assistance aimed at helping the people to help themselves.

The underdeveloped countries of the Western Hemisphere are working eagerly to improve their institutions of higher agricultural education, develop a sound and ever-growing fund of factual research information, and organize an effective system to extend this knowledge to the farms through extension education. The three-prong revolution of higher agricultural education initiated in the United States when President Lincoln signed into law, a hundred years ago, on July 2, 1862, the long-fought Land Grant Act has been an inspiration. The Alliance for Progress could spark a similar revolution in Latin America if a multilateral agricultural institution such as IAIAS is used as a base to initiate a far-reaching program of cooperative research, education, and extension in much the same way the U.S. Department of Agriculture was used to initiate the land-grant-college cooperative movement. Not, of course, to copy or transplant the unified organizational structure that has given such excellent results in the United States because it has been a direct product of the culture, but to develop a functional tie-in of research, extension, and education within the institutional framework in each Latin American country. The money spent this way will multiply itself much more and will last much longer than money invested in a never-ending process of direct technical assistance.

Discussion—Continued

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THE WORLD FOOD PROBLEM is so big and so complex that identical analyses of it by different people could hardly be expected. In this com-

ment I shall try to emphasize only a few points that seem most vital to us.

The world has abundant basic resources of soil

and water for food production. In 1950 we made some broad estimates.¹ The potential harvests from the soils then in use and from the estimated 1.3 billion acres not in use but suitable for cropping are more than ample for some time. Good management as practiced in moderately advanced countries was assumed, not the best. If similar estimates were made today, they would be higher because science and technology have given us better systems of soil use during the last decade.

Although these resources are distributed unevenly, most countries have ample soil and water, within their own boundaries or their customs union, if they were used effectively. China and a few of the smaller countries in semiarid regions may be exceptions. Most of the countries of South America and of Africa have good or even large resources of potentially good arable soils, some of them far from present transport facilities.

Our rapidly improving technology not only increases production per acre and per man-hour but also increases the total number of acres that can be farmed successfully. Many kinds of soils, correctly judged unsuitable a few decades ago, are highly responsive to the new combinations of practices that can be selected from today's technology. Although the total land area of the world may be nearly fixed, the proportion of it suitable for cropping is highly flexible, depending on the state of the agricultural arts, the skills and resources of the cultivators, and the facilities and services for development.

Neither Malthus nor anyone else has found a reliable formula for relating total population to soil resources. Although in the United States, for example, population has been increasing rapidly since the middle thirties, agricultural production has been increasing even faster with fewer acres and many fewer hours of direct farm labor.² Human population will, of course, be limited at some point. Many factors might limit it. But the world has enough soil and water resources, if used reasonably well, to support a growing population for many years to come. In the immediate future, several of the advanced countries are likely to be plagued more with food surpluses than with food shortages.

Generally speaking, present-day agriculture is most efficient in countries with a thriving industry. Perhaps some special factors make the relation less evident in the Soviet Union. Among all the advanced countries, so far as we know, the accumulation of capital for starting industrial growth came out of agriculture. Many have overlooked this extremely vital point in planning for economic growth in the newly developing countries.

¹ Kellogg, Charles E. 1951. *Food, soil, and people*. UNESCO Food and People series. No. 6. 64 pp. New York.

² Kellogg, Charles E. 1960. *Productivity of the arable soils of the United States. 1927-1959*. Trans. Int. Cong. Soil Science 1: xx-xxviii.

The error has several sources. First, the popular interpretations of the well-known Keynesian theory omitted the vital distinctions of the *kinds* of investment that led to growth at different stages of economic development. Then too, the example of the Soviet Union, with its early emphasis on heavy industry, may have misled leaders in other countries. Inadequate agricultural statistics in most newly developing countries lead to inadequate appreciation of the great importance of many investments in agriculture. Steel mills and huge hydroelectric plants are easy to count. But suppose each cultivator family in India, for example, on the average, used one more bag of fertilizer, bought a duster for insecticides, and developed one-tenth hectare of new excellent arable soil!

Economic Growth Depends on an Agricultural Surplus

An analysis of economic history shows clearly that each country that has made continued economic growth was able to do so only after producing an agricultural surplus, either by itself, or within a customs union. Up to now many advisers to the newly developing countries have neglected this vital effect of agriculture on the general economy. The expansion of industry unrelated to agriculture, with the same old inefficient farming, will lead to waste and disappointment. Somehow we must do a better job of explaining why.

Now we are not arguing against industry. Not at all. Full agricultural development requires a thriving industry in the same country or within its customs union. And as technology replaces direct farm labor, country people need other jobs. But in the beginning we should favor those industries that directly serve agriculture (and forestry, fishing, and mining), including those for processing and transport. Once agriculture is going well, other industries "to serve the services" will have a chance to succeed.^{3 4}

The generally low social status of cultivators in the underdeveloped countries is the greatest single handicap to economic growth. Too few village boys and girls have opportunities for education. Even the agricultural research and advisory services are mainly staffed with townspeople. The nonfarm people simply take the cultivators for granted. Few in government know about farming. Most think it is simple: to get improvements one needs only to emphasize a few simple practices. Nothing could be further from the truth.

³ Buer, P. T., and Yamey, B. S. 1959. *Underdeveloped economies*. Science 130: 1383-1387.

⁴ Kellogg, Charles E. 1962. *Using agricultural resources for economic development in underdeveloped countries*. (In press.) In "Food and International Development," Iowa State Univ. Center for Agricultural and Economic Adjustment. Iowa State University Press, Ames.

Basic General Education

Modern farming is highly efficient, but also it is highly complex and highly competitive. Basic general education is a first requirement and should precede vocational training in farming and industry. Fortunately, in most countries, the cultivators themselves put education, or education and medical services, above all else; even though their governments and outside advisers have been slow to realize it.

The cultivator first of all wants his children to live and to be able to read. He knows that people who cannot read stand apart from the mainstream of events; mostly they are left out. Then too, medical services are essential for alert, efficient labor in farming. Cultivators living in social systems that fail to provide them education, medical services, or a voice in their government may appear to us as lazy. But without ability to read, with malaria or other chronic diseases, and with opportunities for only part-time work, who would not appear lazy?

Between the commonly suggested slogans, "no change in the local culture" and "a complete reorganization of the social system," ways must be found to improve the social status of country people. Otherwise we will have neither agricultural improvement nor economic growth.

Interactions

A lack of appreciation of how several practices must be combined—fertilizers, improved seeds, water control, and plant protection, on the same hectares—is the second greatest handicap to agricultural improvement in the newly developing countries. In these countries agricultural education should now give greatest emphasis to combined practices—to the local application of the principle of interactions. All successful farmers in the advanced countries have learned this principle, perhaps even better than their advisers who commonly have had narrower experiences.

Recently several have emphasized the great role of fertilizers in food production. And this is right. They will have a huge role in tropical countries where even the best soils are commonly low in plant nutrients. *But not by themselves.* Nor will irrigation; nor will drainage; nor will improved seeds. Yet, more commonly than not, separate programs along one line or another are being advocated. Irrigation cannot pay unless a good job is done, unless plant nutrient deficiencies are eliminated, unless a proper kind and variety of crop is sown, and unless the crop is protected.^{5 6}

Four basic conditions are met on every arable hectare in the world that has a good harvest: (1)

⁵ Kellogg, Charles E. 1960. *Transfer of basic skills of food production*. Annals. Amer. Acad. Pol. and Soc. Sc. 331: 32-38.

⁶ See footnote 4.

Adequate water and air in the rooting zone, (2) a balanced supply of plant nutrients, (3) a crop with the genetic potential to respond, and (4) plant protection. At least these four must be provided for at the same time on the same hectares. Besides these, seawalls, terraces, small dams, forestry plantings, and other facilities may be needed also.

The practical improvement of an old inefficient agriculture nearly always requires a simultaneous change in crop variety and in methods for soil-water control, fertilization, and plant protection. We may find occasional fields giving a poor harvest that have only one limiting factor to be corrected. But they are rare. Improved seeds on infertile, dry, or waterlogged soils give little result. Fertilizers on waterlogged soil, or even on good soils seeded to varieties selected for generations to grow under bad conditions, return little. And to make matters worse, the cultivator has commonly been told that some single practice by itself, such as irrigation or fertilizer, will help him. When the disappointment comes he loses what little faith he may have had in science and technology.

We should like to emphasize the importance of this principle of interactions; in fact we would overemphasize it if we knew how. This principle applies not only within fields but also to the relations among fields with unlike kinds of soil on the same farm; and especially between the farm and its economic environment—between what the cultivator does or can do and his access to training in new skills, to credit, to markets, and all the rest.

Thus progress requires first joint analyses of the problems and joint inventions for each situation by natural scientists and social scientists working together. Especially in the Tropics, gradual changes from a low level of management to a high level are not commonly economic. Since large additions of chemical fertilizers are usually needed for a good harvest, even on new arable soils, these do not pay out unless investments are also made in water-control measures, improved seeds, and plant protection.

Research in Tropics Meager

We in the advanced countries take for granted the results of agricultural research over the past 160 years. Except for the INEAC in the Congo, now in jeopardy, and a few stations for special tropical crops, we have had little basic soil and crop research in the tropics as compared to the temperate regions. Even now most people in the Tropics look too much for principles in Europe, Canada, and the United States where soils and other growing conditions are very different.

After a rapid tour of less than a week, I was asked to recommend agricultural programs for a large and populous province in the margin of the Tropics. We found no detailed description or laboratory examination of even one of the many kinds of soil. No field experiments worthy of the

name were to be seen. No soil survey had been started. Only on the basis of research in another continent could suggestion be made for soil surveys and for field testing of crops and systems.

This is not a unique experience. Millions of cultivators in the world are using soils of which no scientific examination has ever been made. Thus no one knows where they belong in any system of soil classification, nor how they could be expected to respond to any system of management besides the one they now have. Only the uninformed or the reckless can dare ask these cultivators to adopt new systems without soil surveys and without field trials on representative examples of the kinds of soil.

We should like to contrast two examples: The Gezirah Scheme for cotton growing in the Sudan and the Groundnut Scheme in East Africa, both developed by the British. For the first, on a difficult soil to irrigate and manage, careful research went ahead.⁷ It was a great success. For the other, time was judged to be too short for soil surveys or other research and testing. Soil scientists apparently came in only for the postmortem after the inevitable failure.⁸

The most basic principles and the skills of learning can be transferred between skilled people in the temperate regions and those in the Tropics and subtropics, but only a few farm practices. The farm practices themselves must be invented on the spot in the light of basic principles and from the results of research done locally. The soils in these regions contrast too much with those of the temperate regions.

We have learned some important facts about tropical soils during the past 30 years, and especially since World War II. We know that many kinds are highly responsive to management, even where cultivators have been getting low yields for centuries. Most soils in such areas are low in plant nutrients for crop plants; but so were they before cultivation. And we must continually recall that the nutrient demands of most commercial crops are much greater than those of native vegetation. Soil surveys have only got started recently

⁷ Crowther, Frank. 1948. *A review of experimental work, Agriculture in the Sudan*. (Tothill, J. D., ed.) London. Pp. 441-449.

⁸ Wood, Alan. 1950. *The groundnut affair*. London. 264 pp. illus.

on a serious basis in most of the newly developing countries. They should be completed before big investments are made. Two unlike soils side by side on the same farm commonly respond very differently to combinations of practices. Even though contrasting soils may be brought to the same high level of production efficiency, this is usually done by quite different expensive routes, and the possibility for loss of investment is very great if the wrong one is chosen.

Unhappily, too high a proportion of agricultural scientists in many of the newly developing countries want to work mainly in a laboratory or at least at a field station. Modest laboratory and field plot studies are needed. But two things are needed a great deal more: (1) General research stations with good staff in all lines, including the social sciences, where combinations of practices that take full advantage of the principle of interactions may be competently developed; and (2) research in the field—soil surveys, studies of plants, insects, and diseases, and exploratory field trials of combinations of practices. General research stations can receive and make full use of the basic principles available in the advanced countries. Already we have too many little half-starved field stations working with a single crop. We have far too little research on actual soils in the field and their associated growing conditions—on both the soils that cultivators use and those they could use effectively.

We realize that at least initial progress must and can be made before many new general research studies can be fully organized and really turning out sound results. But the soil surveys and other field research, and the exploratory field trials, could be organized quickly.

To make the transfers of the principle of agricultural sciences to new areas, agricultural advisers need to have unusually high competence in the basic aspects of their fields of learning. They need special skill in the diagnosis of problems and a high degree of inventiveness of combinations of practices, to say nothing of patience. In addition to high competence as specialists, they should be broad in outlook and highly cooperative with other specialists in the natural and social sciences applied to agricultural development. And for the welfare of the cultivators, for continued agricultural progress, and for economic growth, this new agriculture must be efficient and must expand.

Discussion—Continued

C. P. McMeekan

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OUR MODERATOR has emphasized that the main objective of this forum is to examine the status of agricultural knowledge and its application on a world basis. We are concerned specially with

those forces which hinder or insure success in using the know-how that has come from research. My particular role is in the area of animal science, with special reference to the South Pacific, South

East Asian, and Indian zones with which I have had long associations.

Dr. Cuthbertson has painted a most comprehensive picture of the overall scene. He has drawn our attention to the host of complex interlocking factors, all of which must be integrated for the full benefits of agricultural knowledge to be obtained by food-hungry peoples. His presentation has stressed the strength of the many "non-scientific" barriers to progress—those of race, religion, tradition, prejudice, economics, politics, and ignorance.

Throughout my career as a catalyst in the farm production scene, it has been my habit to simplify—many would say "oversimplify"—rather than to complicate, but after a lifetime of endeavor in the developing and underdeveloped countries, I am convinced that a large measure of simplification is essential to rapid dividends from science. In planning any industry for increased output, it is vital that there should be a clear appreciation of priorities. Without this the wood is too easily concealed by the trees.

In my simple philosophy, acceptance of three basic ideas is all that is necessary to transform the animal production scene in the underdeveloped countries:

1. The priority need is to *apply* existing knowledge;
2. In this application, *adaptation* is a key operative word;
3. The greatest barrier to application is *ignorance*, the removal of which will go a long way toward eliminating other significant manmade barriers.

The major principles underlying efficient animal production are well established. As principles, these apply anywhere. By and large, they are simple and their application in any environment is relatively easy to well-trained animal production men appreciative of the force of environment and the need to adapt procedures to suit specific local conditions. Successful adaptive application, however, is dependent upon the level of education of the farm operators involved. These must understand the principles concerned to be taught the necessary skills and methods.

The zone in which I operate should be of special interest to this discussion since it provides such clear-cut examples of the importance of these three concepts and as such can guide us to how we, of the countries of food abundance, can best aid the peoples afflicted by food shortages. In this zone, Australia and New Zealand stand out as amongst the most highly developed animal production areas of the world. They are still, however, in the category of developing countries. The remainder are amongst the least developed and most primitive. Why should this be?

Australian and New Zealand farmers have always been reasonably well educated. They early became aware of the potentialities of science. They

accepted scientific principles. They developed methods of applying these to their peculiar, and in many ways, most difficult environments. They applied the adapted methods with vigor and efficiency. In contrast, the farm operators of the underdeveloped areas of the zone have been, and still are, but poorly educated. A large proportion are illiterate. The vast majority are still unaware of the most elementary principles underlying efficient animal production. Adaptive application is still in the fumbling stage. Methods remain as primitive as they were before the impact of science began to be felt in the Western World.

A closer look at the New Zealand scene will, perhaps, explain why I believe that acceptance of the simple ideas enunciated have such possibilities. In terms of settlement and development, my country is little older than the USDA, whose centenary we are celebrating. Yet in this short time, despite a land area only two-thirds that of California, and a population of under 3 million, it has become the largest exporter of dairy produce in the world, the largest exporter of lamb and mutton, and is second only to Australia as an exporter of wool. It carries nearly twice as many sheep as the United States. It produces a greater volume of animal products per acre and per unit of labor than any other country. It does this almost exclusively on pasture forages—materials not usable directly by man—a point of considerable moment to underdeveloped areas where animals cannot be allowed to compete directly with man for the same food-stuffs. Little more than 100 years ago, New Zealand was covered with dense rain forest and heavy scrub. Its soils were of low natural fertility. Progress was slow in the first 50 years. Agricultural research had hardly begun anywhere, and methods used were those derived from Old World experience. Many of these were unsuited to the new environment. The last 50 years, however, has seen a dramatic change. The application of science resulted in an almost explosive increase in production. Particularly has this been so in the last 20 years, when output has doubled in volume. Even more strikingly, it is abundantly clear that without any further additions to knowledge, or any new land being brought into use, outputs could be doubled again in the next 20 years. Given reasonable opportunities in world trade, they will be so increased.

It is most important to my argument to stress that in these developments, there has been little high-powered science. Our research was not responsible for the principles underlying the methods we have used. For example, we did not conceive the principle of immunization. We did not contribute to the discovery of antibiotics. The name of no New Zealand scientist is associated with the basic physiological studies underlying the technique of artificial insemination. Even New Zealand methods of pasture utilization had their origin in fundamental research in Europe

on the interactions of rate of growth and nutrient yield of pasture plants. The concept of improving pasture plants by selection likewise originated elsewhere.

We have concentrated on taking these discoveries, developing and applying them. New Zealand was the first country to control contagious abortion in cattle on a national scale with Strain 19 vaccine, evolved in the U.S. It was amongst the first to develop field use of penicillin throughout its dairy industry to control agalactae mastitis, and this without a national veterinary service. Though presented with almost insuperable technical and organizational problems peculiar to the local scene, artificial breeding has long since taken over dairy herd improvement. The introduction of the electric fence, the technique of controlled rotational grazing, and understanding of the key role of stocking rate to efficiency of pasture use by grazing animals, have been peculiar New Zealand developments which have taken us to the top as a grassland country. We were early in the field in producing certified seeds even to the stage of developing a profitable export trade.

These four instances exemplify the term "adaptive application" which I have coined to highlight the great need of all developing and underdeveloped countries, if they are themselves to solve their problems of insufficient animal production.

In visiting such countries in attempts to assist, no animal scientist can fail to be appalled at the colossal ignorance of farmers of even the most elementary requirements of an efficient animal industry. The fact that such an industry rests upon the four foundation stones of healthy animals, well-bred animals, well-fed animals, and well-managed ones has not yet filtered through local mentalities at the political, scientific, and administrative levels to the stage of producing effective action. Exotic diseases constitute the first great hurdle. This must be surmounted before schemes of animal improvement can be implemented. The full value from genetically superior stock, and even that from present unimproved stock, cannot be obtained unless better feeding methods are also used. Husbandry in a modern sense, too, is largely nonexistent.

General Practitioners Required

It is true that most underdeveloped areas have trained agricultural scientists aware of the basic needs and conscious of local deficiencies. Unfortunately most of them are specialist, trained by a Western scientific world so far divorced from the realities of primitive agriculture that it has not yet appreciated that the initial requirement is for general practitioners and not for specialists. India does not need high-pressure ruminant physiologists to talk learnedly of the role of fatty acids in cattle nutrition, and to spend their time and the nation's money in laboratory studies chasing the illusory manna of fundamental research.

It needs practical nutritionists with "one-track" minds who can demonstrate to farmers that milk yields would be quadrupled if the existing cattle foods were used by half the present cattle population. At this stage, the peoples of the great rice belts of Southeast Asia do not really need cytologists to study the chromosome complex of the rice plant. They need agriculturalists-cum-animal-husbandmen who can demonstrate the fallacy of monoculture, and who can step up efficiency of output of cereal crops by proper intermarriage of soil, plant and animal, thereby releasing land for the cultivation of animal fodders and the production of protective foods so badly needed. Dairy-men of all these countries do not need endocrinologists to study the physiology of milk secretion. They badly need dairy husbandmen who can teach them how to milk a cow. Along with other tropical areas of the zone, Fiji has no place for a population geneticist to improve dairy cattle, when the first requirement is to secure abandonment of the age-old system of corralling cattle without food at night—the period of maximum grazing intensity of cattle in hot areas. The hill lands of Ceylon, Burma, Thailand, and adjacent countries could extend vastly the available grazing space for goats, cattle, or sheep if developed by men experienced in such operations and who also know how to use efficiently the pastures so reclaimed.

Emphasis Must Be on Adaptation

These simple examples can be multiplied many times. Throughout, the emphasis must be on adaptation. Methods derived from principles evolved in one environment can rarely be applied to new environments without modification. This modification requires commonsense rather than profound research. The large-scale mechanized operations characteristic of much of the agriculture of the more advanced countries have little place as yet in areas where pressure of people on land has reduced the size of holding to such small dimensions that a multifurrowed plough or a combine harvester could not even turn on the fields in use. Yet countries such as yours and mine have expended large sums in presenting such equipment to such areas. Techniques of crop, fodder, and animal production must be adjusted to the local scene by people capable of viewing the farming picture as an entity, and of understanding the people and environment with which they have to work. For this kind of operation the general practitioner is essential; this is true even in terms of the applied operational research that is necessary for the most efficient application of scientific principles to difficult environments.

I believe that in failing to appreciate this elementary truth, we of the countries of abundance have let our less-fortunate brethren down badly. We have opened our schools and universities to their young men, but we have far too often given them a *training in pure science* which totally un-

fits them for service to their motherland, to whom, in consequence, they become mere ornaments. Too often, too, in responding to requests for technological aid, we have supplied these countries with high-caliber scientists who are completely lost when faced with primitive systems of farming of which they have no ken. Unfortunately also, our own training has tended to become ever more specialized of recent years in the race to keep pace with our rapidly developing technology. In consequence, most of our educational centers are no longer capable of turning out the general practitioners so badly needed by others. It could well be argued that even for our own welfare, some return of the pendulum is desirable—that we, too, need the broadly based agricultural scientist both for sound operational research in the applied field and for better extension of knowledge to land operators.

Needed, a Three-Pronged Program

If we are to be of maximum use in passing on our knowledge of modern agricultural science to these peoples, we must have a three-pronged program:

1. We must take men from these areas for training in applied research, insuring for them a broadly based experience and appreciation, aiming at developing people capable of adaptive application of existing knowledge.
2. We must take men from these areas for training as general practitioners in the field of modern agriculture in its broadest sense, so that they, in their turn, can train the army of general practitioners needed on the home front.
3. We must supply men of both categories to initiate applied adaptive research, teaching and demonstration in the countries concerned to speed up the process of overall education.

Such men must be from amongst our best. They must be experienced and dedicated.

All this assumes that the problem of both calorie and protein shortage of food for needy peoples has got to be solved on the spot. It assumes that each such area must become self-sufficient in food production. I cannot subscribe to this. Many areas of the more kindly temperate zones have enormous potentials for increased productivity, particularly of animal foodstuffs. They have the tremendous advantage of already being populated by farmers with the technological know-how. They have the resources to justify still more basic research of the objective type. In a land-use sense they are better adapted to many forms of food production than are the underdeveloped areas. It is true that only 7½ percent of world food enters world trade at present. It is equally true, however, that this could be substantially more if the potentials of countries of food abundance were fully exploited. The resulting contributions to needy nations would go a long way toward bridging the current nutritional gap and in helping them over the long transitional stage ahead before self-sufficiency is even dimly in sight.

That we should be taking land out of production and imposing other brakes on output at this stage in history, rather than facing up to the challenge of devising workable ways and means of making international trade in surplus foodstuffs possible, is to me an admission of intellectual bankruptcy of which we cannot really be proud. Might I suggest that reversal of this form of thinking in such a way as to benefit all mankind might be accepted as the greatest task ahead of the great institution whose contributions over the last 100 years we are honoring today. May I hope that the solution does not take another 100 years to find.

PANEL SIX

In the closing minutes of this session, Mr. Bruce Meeker, Foreign Agricultural Service, USDA, observed that "it is much easier said than done." He referred, of course, to the difficulty of getting adequate agricultural production in the developing countries.

In response, Sir John Crawford said in part, "There is a tremendous inertia in the countries concerned and in the advanced countries, too. This inertia can only be broken down—by a painfully difficult process of attacking a number of problems concurrently.

"I do not believe that it is possible for individuals separately or even organizations with the best will—to undertake effective programs—unless there is very careful and deliberate intergovernmental discussion and agreement. Otherwise initiative from the United States or Australia can be too readily dubbed as another form of colonialism, an attempt to protect their agriculture, an attempt to get rid of surpluses, if you have any."

THE WORLD AGRICULTURAL SITUATION AS RELATED TO ECONOMIC DEVELOPMENT AND CHANGING ECONOMIC PATTERNS

Introductory Statement

Philip V. Cardon, Moderator

Former Director-General, Food and Agriculture Organization of the United Nations

PANEL SIX has been assigned this topic: "The World Agricultural Situation as Related to Economic Development and Changing Economic Patterns." It is one of three topics, for separate panel consideration, falling within the general theme of this morning's Plenary Session; i.e., World Agricultural Trends. The other two panels, four and five, respectively, are at this moment considering "The World Agricultural Situation as Related to Political and Social Trends," and as related to "Knowledge of Science and Its Application."

To discuss our phase of the World Agricultural Situation, the World Food Forum has assembled a panel eminently qualified to appraise economic development and changing economic patterns over a wide front. An Australian, the principal speaker, will emphasize some coming issues in world agriculture and lay stress upon challenging trade and development policies. From Belgium, our attention will be drawn to shifts in policies that have taken place through the years, and to

the significant development of the European Common Market. And then the thinking of broadly organized agricultural producers will lay before us international concepts of great moment. Finally, from the United States, we shall obtain a glimpse of what is foreseen in this country, through the eyes of an internationally experienced researcher and those of an able observer from the ranks of action programs.

Personally, I welcome this worldwide approach to our topic. For the United States, agriculturally, has drawn heavily upon past developments in various other nations; and doubtless will be one of the beneficiaries of international endeavor further to advance world agriculture.

The procedure to be followed here has been accepted by the principal speaker and the discussants. It is designed to expedite introductions and to provide within time limitations maximum opportunity for audience participation.

The World Agricultural Situation as Related to Economic Development and Changing Economic Patterns ¹

Sir John Crawford

*Director and Professor, The Research School of Pacific Studies
The Australian National University, Canberra, Australia*

THIS PAPER attempts to place some very large issues of policy before this forum. In it I suggest that during the next 40 years there will be a major food problem in the world and that a self-sustaining solution to it must be found at best during the first or, at worst the first two, of these four decades.² This solution calls for greatly increased production within the regions of greatest need. These happen to be the less-developed areas of the world. Trade cannot itself offer a full solution, but will, nevertheless, have a critically important role to play. The character of trade will almost certainly change: "noncommercial" transfers will increase in significance and there will be great pressures toward integration of world trade policies relating to foodstuffs and probably some other agricultural products too.

The principal elements which prompt this broad thesis are—

- (a) Growth in world population and the likely regional pattern in the next few decades;
- (b) Association of low incomes (and restricted food standards) with regions of great population pressure;
- (c) Low standards of agriculture in some of these regions, especially in Asia;
- (d) Need for raising agricultural production to meet added food requirements and as an

¹ Sir John spoke more specifically to the subtitle "World Agriculture—Some Coming Issues in Trade and Developmental Policies."

² I am indebted to my research assistants, Mrs. N. Anderson and Mr. R. L. Gray for considerable help, by way of "devil" and critical comment in the preparation of this paper.

integral part of total economic development in these areas;

- (e) Scope for, and limitations on, trade both as a means of insuring economic development and as a source of food supply;
- (f) Barriers to trade which limit the operation of comparative advantage as a determinant of trade and which call for coordination of commercial and noncommercial transfers of foodstuffs between nations.

I will briefly review these points in the next three sections and then offer a few but far from comprehensive remarks on two conclusions which to me seem to emerge clearly enough. One is the need to give, in our aid programs, an even larger emphasis than now to direct ways and means of raising agricultural output in the low-income areas of the world. The other is the need for developing much further than we have our multilateral relationships in trade and aid programs.

IT WILL NOT take long to cover the first but most imperative element in our total problem, the extraordinary and potentially explosive growth in world population. I say "potentially explosive," for my basic assumption is that the object of policy will be to falsify the Malthusian expectation that, unless moral restraint were practiced, the pressure of population growth on limited food supplies would lead to vice and human misery, and that wars, pestilence, and famine would provide checks to the growth in numbers.

Table 1, which uses the median results of the latest U.N. projections, gives world and regional data for the years 1960 to 2000.

TABLE 1.—*Estimates of world population growth, 1960–2000*

[In millions]

	World	Africa	North America	Latin America	Asia	Europe, including U.S.S.R.	Oceania
1960.....	2, 910	237	197	206	1, 620	639	16
1970.....	3, 478	278	225	265	1, 980	711	19
1980.....	4, 220	333	254	348	2, 470	792	23
1990.....	5, 135	410	283	455	3, 090	871	26
2000.....	6, 267	517	312	592	3, 870	947	29
Increase 1960–2000:							
(a) Numbers.....	3, 357	280	115	386	2, 250	308	13
(b) Percent increase over 1960.....	115	118	58	187	139	48	81
Increase 1960–80:							
(a) Numbers.....	1, 310	96	57	142	850	153	7
(b) Percent increase over 1960.....	45	41	29	69	53	24	44

TABLE 2.—*Population and net domestic product, 1955*

	Population		Net domestic product		Net domestic product per capita (US\$)
	Total (million)	Percentage distribution	Total (\$ billion)	Percentage distribution	
North America.....	182	6.8	342	38.5	1,875
Western Europe.....	297	11.0	183	20.6	615
Oceania.....	13	.5	12	1.4	955
U.S.S.R.....	197	7.3	109	12.3	550
Eastern Europe.....	112	4.2	51	5.7	455
Latin America.....	183	6.8	48	5.4	265
Middle East.....	95	3.5	15	1.7	160
Asia.....	1,418	52.7	107	12.1	75
Africa.....	193	7.2	20	2.3	105

The order of magnitude of population growth, both in world and regional terms, is now discernible for the next three or four decades. I assume a world population growing from 3 billion now to over 6 billion in the year 2000, passing about 4.2 billion in 1980. Within this, Asia's share will grow from 56 percent now to 62 percent in 40 years, or from 1.62 billion to 3.9 billion. Its numbers will probably be 2.5 billion in 1980, a growth of 53 percent over 1960. Within these figures the two giants are, of course, India and China. It is suggested that India's population will be a little over 600 million in 1981 as against about 430 million now. China's numbers will be nearer 860 million, or about 200 million more than now. For reasons I do not have to spell out, they are the major laboratories today for social scientists interested in problems of population pressure and economic growth.

The further we get away from 1960 the more conjectural will estimates be. Decline in fertility on a wide scale brought about by sponsored family planning policies or more subtly by an increase in living standards may occur before 2000: in my view it is not likely seriously to affect our projections for the year 1980; that is, for the next 20 years. In this period it seems safe to assume that we will have a growth rate of 2.1 percent per annum in Asia, 1.7 percent in Africa, rather considerably more in Latin America—2.7 percent; and an average of 1.9 percent in the world as a whole.

In terms of absolute numbers, Asia offers the largest problem—as it does also when we turn to the income picture. Table 2 which, for its convenience I have borrowed from Thorkil Kristensen (1),³ is now dated a few years. However, this fact does not affect our argument.

It is highly probable that these figures understate Asian income, for it is difficult to measure noncommercial product of the farms which are

largely subsistence in character and support about 75 percent of the people. Even if we were to allow for this quite substantially, the contrast would remain both startling and ominous. Thus, it appears from Kristensen's table that in 1955, North America had an average per capita income of £1875, accounting for 38.5 percent of the estimated world net production, although providing only 6.8 percent of the world population. Asia, including Japan, had an estimated average income of \$75 per head, producing 12.1 percent of the total product with almost 53 percent of the world's population. Raising the Asian figure to \$100 per head would not greatly moderate the contrast.

At this point, however, low incomes suggest low nutritional standards—and this, no doubt, is right. I rather shy away from trying to picture relative food standards in any absolute terms of consumption of calories and proteins or of expenditures on food. I have too much respect for the strictures of Prof. M. K. Bennett (2) and Dr. Helen Farnsworth (3) of the Stanford Food Research Institute to use uncritically the heroic efforts of FAO and the USDA in various publications, to give us food balance sheets. Fortunately my argument today does not call for precision, although it does call for indicating the problem ahead in terms of rough orders of magnitude.

I am satisfied that we do not have a world in which 70 percent of the population is close to starvation all the time. Nevertheless, I accept the proposition that hunger is a real experience or a constant threat for more than half of mankind. I certainly take the view that, in the poorer countries of the world, there are some regions of continuous undernourishment and others in which undernourishment occurs in most years for some part of the year; that were more food readily available per capita consumption would rise; that as economic development calls for more physical effort from farm and nonfarm labor in these countries, calorie and protein requirements will

³ *Italic numbers in parentheses refer to References, p. 145.*

rise;⁴ and that as incomes grow there will be a rise in demand for foodstuffs with changes also occurring in the composition and quality of food sought.

Since my interest today is concentrated on the poorer areas of the world, more particularly Asia, I feel safe in arguing that there must be an increase in food supplies which is greater than the increase in population numbers. The increase in total demand will be the aggregate of two components, population increase and a proportion of the expected increase in per capita incomes. We have seen that populations in Asia are likely to grow by over 50 percent in the 20 years (table 1), so calling for at least a proportionate increase in food supplies. If incomes per head grow only 1 percent per annum in this period or by 22 percent in 20 years, an income elasticity of demand of 0.5⁵ applied to the whole period would yield a further 11 percent increase per capita in demand for food. This, allowing for the increased population, would bring the total increase of 67 percent or more by 1980. The average annual increase in demand, if we project smooth population and income growth curves, would be of the order of 2.6 percent per annum. This may appear to be modest but is in fact a large order of increase even in terms of American, Australian, New Zealand, and Japanese historical experience.

Quite apart from the paucity of reliable data, it is difficult to make quantitative predictions. It is better to state the problems which are associated with any large order of increase in demand for food. The illustration just given is dependent upon a population growth of 50 percent; an increase in average real income of 1 percent per annum; and an income elasticity of 0.5. Assume now that average real incomes per head rise by as much as 3 percent per annum and assume further an application of an income elasticity of only 0.4 to the period. The total demand would now rise by 98 percent, or at a compound rate of 3.5 percent per annum. That is, demand for food would double in two decades.

This second illustration demonstrates the danger of using even a modest income elasticity assumption over a 20-year period. It would become absurd if we raised the rate of growth in national incomes per head to 4 or 5 percent per annum. Our primary interest is in the demand for basic

foodstuffs, especially food grains. If applied to food grains the results in this illustration would imply that present supplies per head could safely be increased by one-third. Such a result needs to be treated with caution.

It is not likely that rising incomes in Asia would alone lead to 48 percent increase in demand for food grains (population growth accounting for the other 50 percent in our illustration). At the rate of growth in incomes assumed (3 percent), the income elasticity might well be higher than 0.4 in the early years and even remain quite high for food. However, the demand for grains would slacken relatively to the demand for more expensive foods (more appealing cereals, vegetables, meat, milk) and probably for "service" elements (packaging and quality). This change in the quality and composition of demand may lessen the pressure on supplies of grains: it is likely to render more acute the difficulty of supplying protein and "protective" foods on an adequate scale.

In short, it is difficult to predict much more than that population growth will, by 1980, call for some 50 percent increase in supply of food grains over that available in 1960, and that a further increase will be needed (perhaps approaching 20 percent) if the rising demand associated with income elasticity is also to be met. This suggests, as shown later, a required increase in supplies by 1980 in Asia (excluding China) of about two-thirds of 1960 levels, or some 90 to 100 million tons of food grains.

There is much room for more research into the empirical facts about these variables, including the pattern of demand behaviors in farm and urban communities under conditions of rising population and incomes. Nevertheless, some three comments can readily be made merely on the basis of these illustrations.

The first is that there must be some incentive given to the farm community to insure the necessary rate of growth. This may call for an increase in farm prices relatively to the general price level, in which case the effect of rising incomes on the demand for food by urban workers may be offset in some degree by the adverse effects of rising prices. Farmers, in process of shifting from subsistence to cash farming, may or may not have a high-income elasticity of demand for food: much depends on their anxiety to receive urban goods.⁶ The truth is that we do not know enough about this problem. It may be possible to insure farm expansion without raising relative prices, but by persuading farmers that increased inputs of fertilizers, better seeds, and different farm management practices will increase productivity per acre *and* net farm incomes. This approach could be reinforced by improved and cheaper farm credit services, fertilizer subsidies, and so forth.

⁶ Or, for example, the disincentive of a taxation system related to commercial sales.

⁴ Conversely, greater availability of food may make harder labor not merely possible but may also affect attitudes (e.g., willingness to expend more effort).

⁵ It is quite likely to be higher than this in the early stages according to such evidence as I have seen. See also Johnston and Mellor (4), ECAFE (5), and Groenvelt (6). It will be observed that the illustration assumes the applicability of this approach to the whole population, urban and rural alike. As is noted later in the text, it is highly unlikely that a relatively high income elasticity would be sustained over two decades. The higher the actual rate of growth in incomes, the more quickly would income elasticity of demand for food grains fall.

In some areas farmers will turn to nonfood cash crops—e.g., rubber. If this happens, food imports may be possible as the result of exports. For a region as a whole, this is not likely to be a major solution as I will suggest later, but may be important in some smaller national units.

The second comment follows from the first: if farm output is not adequately stimulated by appropriate incentives, then inflation will occur or, alternatively, tight rationing controls will be necessary.⁷ This is only another way of saying that the expected growth in population and in income per head will lead to a substantial pressure of demand on food supplies. This pressure may not be proportionately reflected in world trade prices for reasons I will give later.

I do not expect imports from surplus-producing regions to close any large and growing gap between regional demand for and supply of food. This leads to my third comment, which is to raise the question whether it is feasible to assume that food production can be expanded in Asia to match population growth, given the land and other resources available. In this paper I assume that the answer is yes, although I do assume substantial aid by way of transferring knowledge and resources from advanced countries.

It is worth emphasizing that this assumption is a critical one to make in view of the backwardness of agriculture in most of Asia today. Let me remind you of what is common knowledge about agricultural productivity in Asia. With the outstanding exception of a few areas, and especially Japan, yields per acre are low. Holdings are small, farming methods traditional and soil-depleting rather than modern, seed varieties not good, fertilizer usage too low, price experience often unstable, capital for improvements scarce and costly, labor frequently too abundant, and, not least, illiteracy among farmers too high. The picture varies and in recent years there have been signs of stirring and willingness to change.⁸ Japan is the example of what can be done, given education, research, extension, appropriate price and credit policies, and a generally accepted national objective.⁹ It has taken Japan several decades to get above her agricultural problem, but she has in recent times, unlike other parts of Asia,

⁷ See Mellor and Johnston, *op. cit.* (4), and David Felix (15).

⁸ See ECAFE Survey (19), for a cautious but hopeful note to the effect that recent improvements are more than can be explained merely by good seasons.

⁹ The complementary character of the inputs, including farm education, is to be noted. Any substantial achievement requires a comprehensive and many-sided policy. Yet, when everything is at low standard, one single line of attack may be important. Thus the FAO Fertilizer Report (10, p. 43) argues: "Fertilizers alone, on otherwise most primitively farmed land, have often sufficed to cause a 50 percent improvement in yield, without any other change in the old-established methods of cultivation. This is a spectacular result in the eyes of the cultivator, who is then encouraged to make an all-round improvement in his standard of husbandry."

been helped by a marked slowing down in rate of population growth and a no less marked increase in incomes per head.¹⁰

All this is highly generalized and too superficial. Moreover, rather less than justice is accorded to the fact that the Asian region (at least if we exclude the more uncertain position in China) appears to have expanded agricultural output sufficiently to recover to prewar per caput production levels.¹¹ There are signs that recently good seasons (excepting again in China) and technological improvements have together raised the rate of growth in farm output—a good beginning in what will surely be a long haul.

Yet the fact remains that yields in Asia, outside Japan, are the lowest in the world. It is enough to take some estimates of the Foreign Agricultural Service (cited by ECAFE (?)) made in 1958 and which suggest that the Far East produced about one-third of the world's agricultural production in 1955–56. This, considered in relation to her 52 percent share of the world's population, reflects not merely a small supply of farming area per head of population but also lower productivity per acre.¹²

For a particular illustration of the last point, we may take rice yields, as derived from the FAO Production Yearbook for 1960, for the year 1959–60:

	<i>Yield of rice (paddy) (pounds per acre)</i>
India -----	1, 210
Japan -----	4, 240
Indonesia -----	1, 540
Burma -----	1, 520
China (mainland) -----	2, 410
Malaya -----	2, 130
Australia -----	5, 310
United States -----	3, 350

¹ 1957–58. The figure for 1958–59 is given as 3,100.

To cite only one point of contrast between India and Japan: the latter uses an average 4½ tons of fertilizer (mostly organic) per acre, while India uses very little—at most 2 or 3 pounds per acre—"not enough," according to FAO, on average, "to replenish the losses from the soil that occur each year as the result of cropping" (10).

Assuming that rice yields are typical of other food grains in the area, it can readily be understood that the task of raising food supplies by 50

¹⁰ While it may be assumed that price policy has been important in the Japanese story, it is possible other factors were more important. Certainly the Japanese farmer has accepted a quite heavy taxation policy. Perhaps a certain docility in relation to national policies has been the key factor. (See Johnston (16) and Smith (17).)

¹¹ The ECAFE Survey ((19), p. 119), however, offers a word of warning. Recent censuses in Asia have so raised population counts above earlier estimates that the estimates of increase in per capita output have necessarily been modified.

¹² Once again precision is unnecessary to make the story. A similar picture is given in the recent FAO Report on "Development Through Food" (8); see also Kristensen (9).

percent, i.e., *pari passu* with population growth alone, in 20 years is a large one, calling for a vigorous program on the whole gamut of problems inherent in the present low standard peasant economy that now dominates the region. To allow for the uncertain but positive effects of income growth, as indeed we must, merely makes the task more formidable. I, nevertheless, assume that the problem is soluble technologically by the use of additional lands and, far more importantly, by raising productivity on land now in use. That is, I believe, the output (per acre and per person) can be raised by increasing fertilizer usage, introducing better seeds, controlling pests, improving water usage, raising literacy standards, and by the use of complementary price or input subsidy policies. Technological innovations in Asia can for some time yet stave off or greatly lessen the effects of diminishing returns as inputs are added to a relatively fixed factor, land.

Nor is the problem merely a technological one. This gives us only the "in principle" solution—the land resources *can* yield the results required. This calls for action on many fronts and means no more than that social, economic, and political barriers which now stand in the way will be broken down to enable the available "in principle" technological solutions to be applied effectively in practice. In this paper I beg all these questions, knowing that failure can only mean victory for the worst Malthusian fears.

I have stressed this assumption about technological capacity in Asia for I find it necessary to discount the notices that trade can meet the need we are discussing. There are good reasons for thinking it impracticable to look to international trade alone or even as a major¹³ means of meeting the growing need for food. I also suggest that it would be *unwise*, even if it were feasible, to look to trade as the major source for an expanded food supply in the underdeveloped areas of Asia and Africa.

Let us look briefly at the reasons why it is impracticable to look to external trade to meet potential deficits in food supply in the next 20 years.

(a) The first relates to the relatively small quantities of food normally entering supplies by means of international trade. Authorities differ,¹⁴ but using FAO data (12), we can indicate that present production of food grains in Asia (excluding mainland China) is well over 130 million tons (including rice at milled equivalent).

¹³ Kristensen would seem perhaps not to accept this. His calculations ((11), ch. V, table V, 16) point to substantial imports of foodstuffs to meet the problem in Asia. He suggests that the needs of Asia (including China) will require imports at a level between 18 and 22 percent of consumption (low and high projections, respectively). Net imports into Asia at present constitute little more than 7 percent of consumption (estimated production and imports) if China is excluded, and considerably less if China is included.

¹⁴ See Kristensen (1), Groenvelt (6), FAO (8).

Net imports into the region are at present about 10 million tons (excluding maize) so that a two-thirds increase in demand in 20 years would call for well over 90 million tons.

Total world exports (commercial and non-commercial) in all grains (excepting maize) in 1960 were about 52 million tons, of which some 16 million were imported by Western European countries and 14 million by Asian countries. This latter figure excludes mainland China to which an uncertain amount went. Even if all the present export (mostly wheat) was channeled into Asia¹⁵—a highly unlikely supposition—it would not meet the total prospective need by 1980.

Some increase in import supplies no doubt can and will be managed to meet Asia's grain needs—and Europe's Common Market policies promise to release more in the future. Nevertheless it is well to remember that the needs of other continents will also expand.¹⁶ Total trade in grains, now representing some 10 percent of the world's consumption of cereals (about 550 million tons, excluding maize and excluding China) is not likely greatly to exceed this figure. (It is about 16–20 percent for wheat and about 5 percent for rice.) If Western Europe's net imports of grains were all diverted to Asia, for instance, it would mean another 13 million tons of grains (excluding maize), of which 7–8 million tons would be wheat. This could be the situation if Western Europe became self-sufficient. This would raise Asia's 10 million tons of grain imports (excluding China) from other regions to a hypothetical 23 million tons. A realistic figure would perhaps be 20 million tons, but much depends upon the terms upon which trade takes place.¹⁷ (I ignore the problems of shipping and handling which are not really insuperable at these levels and certainly not more difficult than the task of expanding agricultural production in Asia.) Even at these higher levels we are a very long way off the possible additional need per annum (still excluding China) of some 90 million tons or more.¹⁸ (It is worth

¹⁵ Thus ignoring important intraregional movements (but nevertheless international trade) likely to continue as, for instance, in Latin America and Europe.

¹⁶ As could production in North and South America, Europe, and Australia. However, the cost factor, noted later in the text, makes it unrealistic to count very much on extra production in these areas for any dramatic expansion of exports to Asia.

¹⁷ If China is included in these calculations, as it ought to be, it becomes even less realistic to look to trade for any major share of the anticipated increase in demand. Total demand may well rise, in Asia (including China), from say 350 million tons to say 575 million tons per annum before 20 years have elapsed. Even if imports rose to 50 million tons, an increase of 175 million tons in domestic production would be called for.

¹⁸ A good deal more work clearly needs to be done on this: I have limited myself to suggesting the danger of looking to simple transfers of food from surplus to deficit areas. The transfer may not be simple and is not likely to take place on an adequate scale. That it will, nevertheless, continue to be important I suggest later in the text.

noting, in passing, that intraregional trade in rice in Southeast Asia has declined in importance compared with prewar. The rice "surplus" available for export from Burma, Thailand, and South Vietnam, and other exporters in Southeast Asia is now under 4 million tons compared with 9 million prewar, reflecting in part, no doubt, a rising domestic consumption as well as reduced commercial imports of rice in favor of wheat imports or home production by India and Japan and other importers in the area.)

(b) I have done no more than throw doubt on the likelihood of supplying, through trade, the added physical quantities of grain Asia will require. There is another strong reason reinforcing this doubt. To the extent that we are discussing commercial trade, these countries could not afford to import an increasing amount year by year. Every million tons of grain added to imports on a cash basis would cost about \$70 million to \$80 million. This for an area, largely in severe balance-of-payment difficulties, and requiring an annual increase in supplies of food grains of 3 to 4 million tons, perhaps rising, in total, to well over 90 million tons in 1980 as compared with 1960, is sufficient economic justification for seeking to produce requirements at home: It is a proper sort of import replacement. Let us assume that 20 million tons were imported (of the 90 million extra needed in 1980). At present market prices this would probably cost about \$1,500 million, or an increase by more than 50 percent in the present excess of total import costs over export earnings for the region (excluding China).¹⁹

This argument fails if the richer producers of the world supply the extra quantities free. Not even Public Law 480 is entirely free,²⁰ but let us double such supplies from United States and elsewhere now going to Asia²¹ and count on building up to 8 or 10 million tons.

The balance of requirements, even if it could be supplied physically by producers in advanced countries, is likely to be beyond the foreign exchange resources of the areas most needing the supplies. Certainly it would not be sensible policy for governments in these areas to rely on an extremely conjectural ability in the future to finance large imports of grain from export earnings. It would be most unwise not to husband future export earnings for imports of capital goods and other items which cannot be produced domestically.²²

¹⁹ A rough calculation derived from ECAFE (R) indicates export earnings for the region in 1960 of \$10,824 million and imports at \$13,040 million, a trading deficit of \$2,216 million.

²⁰ See my paper given in Mexico, August 1961 (M).

²¹ Or available to be shipped under existing contracts.

²² My illustrations are on a basis of 1980 projections. The policy arguments have even more force in the period of 1960-70, for failure to expand food production in this first decade would certainly throw a great financial strain on needy areas. India plans to be self-sufficient by 1965.

(c) The third reason for not relying on imports is simply that raising agricultural production and productivity is a vital and integral part of economic development in Asia as in other low-standard areas. For some countries export earnings may be increased in this way. For others the need is to feed their growing populations at high standards and to provide in this way a growth in incomes, capital, and labor supply complementary to industrialization programs.

It is not necessary for me to spell this out in detail.²³ Whatever general statement is made is bound to require, in respect of its component elements, varying emphasis in relation to any particular country under review. It is well to remember that most of the underdeveloped countries of interest to us are characterized by a high proportion engaged in low-standard agriculture and by the sheer necessity—in one way or another—to provide extra food for a growing population. In addition, all have as a major objective the raising of income standards as expressed in food, shelter, clothing, and services such as education and health. Finally, employment has to be offered to unemployed persons in urban areas and to underemployed people (mostly in agriculture). Investment has to be made on an increasing scale to accomplish these ends.

Agriculture, we have noted, makes one contribution if it expands production and hence food supplies (or, in some cases, additional foreign exchange). When industrialization gets underway and urban employment calls for a transfer of rural population, more efficient farming will make this transfer possible.²⁴ (This is one lesson from industrialization in Japan as well as the higher income industrialized economies of the West.) Again, higher cash incomes in the farming sector increase the market for industrial products—both farm goods (machinery and fertilizers) and consumer goods. Through an appropriate taxation system, agriculture will contribute to capital formation for nonfarm investment. Farmers must, however, be able and encouraged also to invest in their own farms; otherwise the required productivity will not be forthcoming.

Rising agricultural productivity therefore has a role to play, going beyond the necessity to feed a growing population. It is beyond the scope of my paper to pretend to outline the necessary answers to the many practical questions which arise for policymakers endeavoring to promote agricultural

This is probably optimistic, but certainly the Indian Government ought not to rely on more than 4 or 5 million tons import and that predominately aid.

²³ If I must identify myself, I put myself in with those who accept Nurkse's general analysis and the more detailed statement given by Johnston and Mellor (4). In this short statement I follow the latter authors.

²⁴ Even if agricultural output is raised without reducing the labor force on farms, an expansionist program under new technological conditions may well (and ought) reduce the economic opportunity over the period for additional numbers to be employed on farms.

production. I have already indicated what will be obvious to this audience: the need to apply research, extension, and suitable farm credit and pricing policies to the farm sector if the necessary results are to be achieved. It is right to emphasize the need to continue and expand technical aid. I suggest that a concentrated attack on fertilizer supply and cost problems would probably be one particular exercise for international cooperation which would yield a large return.

I WISH now, however, to return to the problem of trade. I have argued that a food-deficit region like Asia cannot safely rely on trade, especially on imports of food, to meet the larger proportion of a growing need and demand for food. I hope, nevertheless, that I have not thereby dismissed trade as of no account. It may be marginal in the sense of supplying a small percentage of total need, and certainly the prospects of available surpluses in other continents ought not be allowed to divert attention from necessary internal measures to promote agriculture. Yet trade does have a critical significance even for marginal importers in low-income areas and for those who derive export earnings from trade in foodstuffs.

Let me remind you of some of the senses in which imports, marginal in a quantitative sense, can be critical to the users. We have seen not infrequently in postwar years in the case of India and quite spectacularly in the last 2 years in the case of China, what large differences to trade requirements are made by adverse marginal variations in production within these countries. A 3- or 4-per-cent variation, where reserves do not exist, means special grain imports amounting to 5 million tons or more in a year. Even assuming India manages to get nearer self-sufficiency in grains by 1965-66 (its third plan aim), it seems to me that both China and India will be in and out of the market for substantial tonnages from time to time. This strongly suggests the need for reserves held domestically and internationally.

If reserves are held nationally (e.g., within India and Pakistan) to serve as buffer stocks against production variations, they will need replenishment from time to time. If I may tactfully refer only to non-Communist Asia in this respect, it has long been a source of wonder and disappointment to me that our multilateral programs have not yet successfully encompassed such an idea—both for the original reserve and for replenishment.²⁵ The relevance to Food for Peace campaigns is obvious.

Let me now suggest that aid through food disposals can, within limits, assist general economic

development. This is likely to be especially true in the early critical years when the social and economic barriers to economic progress and expanded farm output are particularly hard to break down.

My own conclusions on this subject (13) are derived from some official experience with the problem of surplus disposals as well as from more recent thinking about it. They can be rapidly summarized as follows:

1. For reasons already given, countries facing a large order of population increase and requiring to develop economically ought to give a high priority to agricultural expansion.
2. The efforts of many such countries (e.g., India and Pakistan) to expand their economies are limited by shortages of economic skills and of foreign exchange for capital goods and essential consumer goods rather than by any scarcity of unskilled labor.
3. Although a rising trend in farm output may be achieved in these countries, there may, and is likely to, be an occasional deficit or even a continuing reliance on imports for a small proportion of total requirements.
4. If no aid program is available, such a shortage, continuing or sporadic, must be met in one or both of two ways: rationing or inflation at home or by the allocation of scarce foreign exchange. In the former case, an important incentive for increased output in all sectors (i.e., adequate food supplies) is impaired. In the latter case, the foreign exchange so used up reduced the import of some essential goods, especially capital goods.²⁶ In this way national development plans are hampered and frustrated.

I believe there is an important modification of accepted FAO principles inherent in this analysis. As an official I always regarded with some skepticism the operation in practice of the principle that Public Law 480 disposals should not disturb commercial trade, especially of friendly allies. I now suggest that Public Law 480 disposals will not assist development to the maximum extent possible unless they do displace commercial imports or are accompanied by free exchange in the form of convertible currency.

Let us assume that a country is importing commercially a certain tonnage of grain but that this (added to home production) leaves it a small percentage short of the supply necessary to meet adequately the demand arising from rising population or rising incomes. Perhaps fairly light rationing is involved or some areas simply go short. In these conditions a Public Law 480 deal, by supplementing normal imports, would offset the shortage and provide the amount deemed neces-

²⁵ See Dr. Sen's remarks: ((8) p. 14 and pp. 42-44). Recent good seasons have apparently enabled India and Pakistan to increase their stocks. (See (19) p. 123.) It remains to be seen whether these will be drawn on and replenished in the manner of true national reserves as contemplated in the various FAO proposals.

²⁶ The basic assumption is, of course, that imports are already selectively controlled in the interest of economic development. The assumption is realistic enough for India!

sary.²⁷ In this way the ability of any given work force to provide a "full day's" work is sustained, since it is safe to assume that any real shortage of calories must impair labor input.

If, however, the maximum long-term benefit is to accrue to a country normally importing grain commercially, it is necessary to replace commercial imports—not merely to avoid the necessity for increasing commercial imports. For, it is in these circumstances (or similarly, if free exchange accompanies the Public Law 480 supplies) that the country concerned is best enabled to increase the import of capital goods and material essential for development,²⁸ and, at the same time, assure its needed supply of food. I realize that this conclusion bodes ill for commercial exporters and, moreover, I believe there has been a substantial adverse impact already. The more adverse that impact, the more likely that the recipient country's development program has benefited—provided always that the exchange named has been allotted to essential imports.

In passing, it is worth remarking that any aid program in the form of essential goods can be supported in terms similar to the foregoing. Aid in the form of fertilizer components or complete fertilizer will either enable a reduction in commercial imports or will allow an expanded effort in the farm sector not otherwise possible. Even more importantly, fertilizer provided on an aid basis would enable a reduction in costs to the farmer—an important element in farm incentives.²⁹

To avoid complications I have so far discussed the food needs of growing population and of economic development in terms of food grains. This of course oversimplifies the situation since an expansion of food supplies calls for a mix of energy and protective foods. Surpluses available for national reserves or for annual Public Law 480 deals are more likely to be in the grains. The adverse reaction a few years ago to the cessation of surplus milk disposal programs indicates the need felt for other types of food.

The more protective barriers and higher price supports foreshadowed under the Common

²⁷ Clearly a small shortage in any one year could be met from buffer or reserve stocks, if available. As noted earlier, a replenishment problem arises.

²⁸ In my Mexico paper (13) I have drawn attention to qualifications which impair the effectiveness of the Public Law 480 program. It is important that food reaches people who need it—hence the importance of proposed studies of programs for directly linking food supply and rural welfare projects. It is also important that domestic agricultural expansion not be discouraged by excessive imports in any form. Finally, it must not become illusory as it is, at least in part, if unavoidable U.S. expenditures (e.g., Embassy operations) are met from the local currency received for Public Law 480 "sales."

²⁹ The temptation is to charge the farmer full "local" costs for fertilizer imported free or at prices lower than domestic costs of production—so obtaining needed revenue or reducing deficit finance ((13), sec. V).

Market program in Europe are likely to add to surplus (unsalable) supplies of grain and dairy produce available from Australia and New Zealand. Comparative advantage may be right for trade in industrial products, but apparently not for trade and production. This may improve the "mix" of surplus foodstuffs available.³⁰ They are also likely to produce surpluses in Europe, at least in some years. As you well know, we together now face a situation in which, on the one hand, there are likely to be some high priced, highly protected markets and, on the other, some markets likely to be the subject of cut price sales, Public Law 480-type deals or, at best, an agreed form of surplus disposal program. Countries like Japan and Malaya, regarded as able to purchase commercially, may well be restless at any attempt to deny them the benefits of the world's unwillingness to allow comparative advantage to determine world trade in major foodstuffs.³¹

If I am right in this crudely expressed diagnosis, we will, during the next 10 years, have a situation characterized by the following:

- (a) Over the next two decades or more, the demand for food will grow rapidly in the newly developing areas, both because of rising population and rising incomes.
- (b) This ought substantially to improve the terms of trade for exporters like Australia, but it is unlikely to do so in fact. For, many of these countries are in balance-of-payment difficulties and, for this and other reasons, must try to expand domestic production of food. In addition, they can expect unwanted surpluses produced in high-income areas (some of them under highly protected price-support programs) to be offered at cut prices or upon completely noncommercial terms.³²
- (c) This last situation will find its maximum rationale if these surpluses can so relieve recipient countries of the necessity to allocate foreign exchange for food imports that, by importing more essential investment goods, national development programs (including expansion of farm output) can thereby be supported at higher levels than otherwise possible.³³

³⁰ In any case I would not rule out deliberately producing some protective foods for use in aid programs. Also, as Dr. Sen, Director General of FAO, has observed ((8), p. 29), some donor countries might well convert grains to protective foods for aid purposes.

³¹ It is hardly necessary to draw attention to the contrast in respect of trade in industrial products, now characterized, among advanced countries, by a strong desire to allow comparative advantage to hold sway.

³² They can expect to benefit, in short, from the refusal of Europe (and to a lesser extent only, United States, too) to let comparative advantage determine the pattern of world production and trade in agricultural produce.

³³ Incidentally, Europe is a major beneficiary of this approach since this continent is a principal supplier of investment goods.

It should be clear by now that the time is overdue for a more comprehensive and more cohesive world food policy than now exists.³⁴

A world food policy must take account of the fact that no "invisible hand" is at work to insure the right amount or composition of economic growth in underdeveloped regions, or to insure that conflicting trade interests in the world are settled according to accepted principles of comparative advantage. On the contrary, there is a great need for concerted international action to produce order out of a situation that can otherwise lead to unwanted and unnecessary economic tensions, not merely between the most advanced and the least developed areas, but among countries at all levels of economic maturity.³⁵

I suggest that international cooperation should cover four categories:

- (a) The establishment and operation (including replenishment) of national food reserves in countries like India and Pakistan.³⁶ Such reserves would be used for emergencies (regional famines) as well as for buffers against shortages of less serious moment.
- (b) The seeking out of zones of nutritional deficiencies for special food programs of more specialist character than those which can be met from ordinary reserves of food grains. (This category would cover rural welfare projects; school lunches in the poorest areas; special foods for protein-deficient areas; and so on.)
- (c) The provision of annual supplies designed to meet, in some part at least, a marginal gap between the average addition to demand and average increase in home-produced supplies in any one year. (That is, if and as home production lags behind the rising annual demand due to population growth.) It is in this category that world agreement must be reached on the marketing of food-stuffs from Europe, Oceania, and North America in countries which need imports but which are regarded as unable to pay prices ruling in these three regions for the

³⁴ It will be noted that I have not dealt with the problems of coffee and cocoa exporters or with the problems of instability of world commodity trade. These problems call for commodity stabilization schemes or some scheme of insurance of "compensatory finance" such as that now under consideration in United States (14). My concern here has been the problem of marrying trade to the needs of population growth and economic development in the low income areas of the world.

³⁵ As already noted, for instance, Japan, in terms of income, is in between "rich" and "poor." It cannot be treated as "poor"; nor can it be assumed that it can yet accept price levels equal to European and U.S. support prices.

³⁶ And any other country in which foreign exchange situation renders international aid inescapable. If international politics could be excluded, China could well come into such a scheme for dealing with emergencies.

full amount of their import needs. A "free for all" would be disaster. The general principle has to be agreement on sharing high cost, high price markets, and on terms of disposal to other markets. It may well be that agreement can be reached only on two extremes—the high price market in Europe and the cases for which Public Law 480-type programs are clearly permissible and desirable. The middle group of markets (Japan, Malaya, . . .) may be open to "competition" with some rules agreed about subsidies. It is highly probable that the major suppliers with surpluses (North America, Europe, Oceania, and perhaps Argentina) will have finally to face adjustments in their home production policies. For reasons given in this paper, they certainly cannot assume that the growing populations in Asia, Africa, and Latin America will automatically take care of all their present and potential surplus under commercial trading conditions.

- (d) The expansion of home agriculture in the present low-standard, food-deficient regions is vital to their economic development and is in any case imposed by the difficulties of expanding export earnings to the degree otherwise necessary. Perversely, if you will, there are strong grounds, mainly of a political nature, for suggesting that advanced countries must offer aid in an effort to insure that these programs of economic development and agricultural expansion succeed. For these reasons I have dared to suggest that specific steps be taken to build up fertilizer supplies and usage in Asia—to supplement present plans and efforts now more widely evident to reform land tenure; to improve credit and pricing policies; and to promote research, extension, and farmer training programs.

Some international action already exists in respect of all these categories. The proposed \$100 million world food program offers modestly enough some possibilities for developing further collaboration in the use of surpluses for emergency relief, nutritional advance, and for economic development. I have implied, without explicitly developing the argument, that this and existing FAO, International Bank, Colombo plan, U.N. Special Fund activities will have to be greatly stepped up, together with efforts to promote effective understandings in GATT about policies governing world trade in commodities. The main imperative is, and I now return to my starting point—what I regard as a great challenge, possibly the greatest, to mankind in this century—the population growth in the next 40 years. This calls for national treatment of trade and aid programs in support of vigorous general economic growth and

of expansion in farm output in the low-income areas of the world.³⁷

I venture to suggest that just as it has given so freely to the world from its century of research and technological advance in agriculture, the United States must, during the next 10 years, lead and encourage all other governments willing to work with it toward a world food policy. It should use its position of strength to press for unilateral action—not so much to share the burden it now carries, but to insure an increase in the total effort required from all of us.

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³⁷ As already noted, this paper has not dealt explicitly with the *export* trading problems of countries (rich and poor) dependent upon world markets for primary produce. Likewise no reference has been made to the need for a more rational handling of exports of simple manufacturers from low-income countries. Yet these problems are of such importance that failure to deal with them will make for further frustration of the economic plans of low income countries especially.

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Discussion

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"THE WORLD agricultural situation in relation to economic development and changing economic patterns" is a subject broad enough to make any speaker's head swim. But it is still more overwhelming when, instead of approaching it on strictly economic terms—that is to say, from the viewpoint of actual supply and effective demand—one has to envisage food requirements not yet backed up by trading or purchasing power.

Many of the difficulties which have been exercising our minds during recent decades would obviously resolve themselves if we could accept Malthus' cynical view that a man who is born in a world already occupied has no right, if society does not need his work, to claim even the minutest food ration and, in fact, he is in surplus.

But no man of the 20th century could write this and remain at peace with his conscience. We have, indeed, gone a long way toward universal acceptance of the philosophy that every citizen of every nation is to some degree responsible for the minimum welfare of every member of the human race.

No one can wash his hands of the responsibility for the plight of unknown millions of men, women, and children living or unborn in faraway countries. And least of all those of us who are privileged to be members of an "affluent society."

For the economists the challenge is therefore no longer that of explaining in a detached way how economic factors combine through enterprise to make the production of goods profitable and how these goods are traded amongst men and nations. Rather, it is so to orient human activities that every one of the increasing number of billions of human beings can, through his work and initiative, enjoy a decent life.

Agriculture, the production of food and fiber, forestry, fisheries, remain the fundamental sources from which man's basic requirements are to be met. It is hardly an exaggeration to state that, in order to satisfy these growing requirements of mankind, absolute priority must be given to an expansion of these industries, wherever throughout the world they fail to measure up to present and prospective needs, and to an ever more gener-

ous distribution of food supplies by those countries having an overabundance thereof.

I would like to omit from my remarks all the essential points so aptly made by Sir John Crawford and on which there is almost unanimous agreement among specialists of all countries: short-term limitations of a birth-control policy, limited opportunities for massive migration, the marginal effect of international trade in relation to growing food needs, and the inescapable necessity of increasing domestic food production, especially in Asia.

I personally endorse these conclusions, but I will attempt to focus attention on a number of related issues about which there is still room for considerable research and discussion—both nationally and internationally—before anything like definite conclusions can be drawn.

The first of these—and it is a crucial one—has to do with the traditional sociopolitical patterns prevailing in most countries where food production lags—or will increasingly be lagging—behind the nutritional requirements of a growing population. It is tempting to avoid debating this problem in any international forum because the risk is great that any criticism will be denounced as an unwarranted intrusion by ignorant outsiders in the cultural and historical heritage of venerable civilizations.

But is it not unrealistic to even begin to consider agricultural production problems in developing areas by accepting as a fact a structure of society which precludes its expansion?

To take an example which is perhaps a shade less controversial than those of landlordism and sharecropping on inequitable terms, or of a feudal system of land tenure, is it realistic to take for granted that domestic trade in agricultural products must remain under the control of a privileged class of unscrupulous dealers who succeed in blocking any attempt to establish cooperatives or even the promotion of a degree of competition in that sector? Alternatively, is it logical to even start a discussion of economic incentives for individual producers when they know that the so-called cooperative system is no more than a cog in the local politicians' machine? Going one step further, is it permissible for the governments of the wealthier countries—where, let it be said in passing, not every taxpayer is a rich man—to lavish aid on countries whose administrations fail to take the most elementary steps towards the creation of a society where the farmworker and his family will have reasonable prospects of receiving acceptable rewards for their labor?

Change Political Systems?

There is, of course, nothing new in these observations. But it is perhaps appropriate at this stage of world evolution to start asking whether or not the most urgent need of a number of developing countries, who as we all know face the

prospect of increasing scarcity of food, is not so much augmented foreign assistance, whether it be technical or financial, as a change in their political systems.

This presumably naive comment is especially relevant in view of the somber picture of imbalance between supplies and needs which is conjured up by statisticians' extrapolations. We may as well pause a moment to ask ourselves what the actual result of worsening food shortages, should they materialize, will be for the peoples of the countries concerned. In other words, to ask ourselves who in these countries will have his diet reduced to starvation level and who will manage to secure sufficient food for himself and his dependents.

If and when the progressive reduction in the per caput availability of calories and proteins reaches dramatic proportions, it is, of course, unlikely, even under the most efficient rationing system (and we, in continental Europe, whose memories of what efficiency in rationing amounts to at best are still green), that every consumer will get a share of an inadequate total food supply at least proportionate to his physical requirements. The chances are that a ruling class or a ruling faction will establish or reinforce a totalitarian system to safeguard its privileges at all costs.

In the economist's vocabulary this can assume various names: rising food prices, lower and lower wages for harder and harder work, etc. But the end result is always the same: a growing number of people, but by no means *all* the people, have progressively less and less to eat; they turn progressively to less and less nutritious foods, see their children die in greater numbers at a tender age, and their own life expectancy decline steadily.

Because poverty at its worst is synonymous with starvation or semistarvation, the temptation is seldom resisted to state, as in many international studies, that the basic cause of hunger is poverty and that the cure for hunger is economic development.

This is apparently one of the few universally accepted notions to which I referred earlier. But is this unequivocal?

Is it true that economic development in the usual contemporary sense—that is, industrialization and agricultural expansion going hand in hand in what is known as balanced economic development—is a precondition to—indeed, is consistent with—the provision of sufficient food supplies for a growing population?

How many of the developing countries who have had the foresight and the talent necessary to evolve development planning on a significant scale have also had the means and the courage to extend their forecasting to that critical period—perhaps 15 to 20 years hence—when the population explosion will make its full effects felt?

Basic industries and manufactures are essential to provide employment, to create purchasing power, and to broaden the basis of the economy,

but they are not, in the last analysis, a substitute for food. And the best conceived programs, even the most successful programs of industrialization, may in the end leave certain countries better equipped to supply their populations with consumer goods but still short of the basic food they need. Emerging nations are often inclined to believe that any advice to give priority to their agricultural development is prompted by a Machiavellian design intended to perpetuate some form of "colonial pact."

But the truth is that it is not for any reason related to an international division of labor between industrialized and nonindustrialized countries that agriculture should be given a higher priority in many developing countries. It is more simply because of their own prospective food needs.

Be that as it may, let us now turn to another controversial question—one which does not involve the feelings and the interests of people in developing nations only, but also those of people in wealthier countries as well, a question which has, for 15 years, sharply divided nations at international conferences. Let us consider whether there are reasonable prospects that developing nations will, in future years, become larger importers of food on commercial terms. Whether, in other words, they will be able and willing to *purchase* food from the wealthier and more productive nations on world markets.

At this juncture I am driven to make bold, and therefore controversial, statements. I believe—

- (1) That whatever success developing nations with fast-growing populations manage to achieve in expanding their economy, increasing their national product, overcoming barriers to their export trade—they will not, in the foreseeable future (even with the help of a considerably stepped-up supply of foreign capital, both public and private), earn enough foreign currency to finance at one and the same time the fundamental import requirements of equipment and raw materials associated with such economic growth *and* food supplies.
- (2) That there is, therefore, a quasi-certainty that most, if not all, of the food-import requirements of developing nations will have to be met from international aid granted especially for that purpose or from so-called surplus utilization programs.
- (3) That it is most likely that all the efforts made by food-exporting countries to protect what they consider to be their prospective markets in developing countries (particularly by opposing a greater and faster expansion of surplus utilization operations) will have been in vain.

And I draw from these premises the conclusion that agricultural exporting countries (with the sole exception of the United States, who happens

to have both the food surpluses and the financial wherewithal to conduct a Public Law 480 program), who look to developing countries for outlets, would in their own interests be well advised to promote and support multilaterally financed and managed food aid programs.

Such conclusions are, of course, equally unpopular with food exporters (who like to dream of an expanding commercial market for their produce) and with developing countries in need of food (who like to dream that they will eventually become customers in good standing rather than perennial recipients of food aid). But I have to remind you that, although despised and ridiculed, Cassandra was, after all, the one who, according to Homer himself, proved to be right.

The only alternative that I can envision would be an international program placing dollars for the purchase of food on commercial terms at the disposal of countries in need.

A policy to restore international commodity markets to their past glory could be crowned by such a program. But this will in all probability be unnecessary because it is most unlikely that the industrialized countries will, in the foreseeable future, abandon the domestic agricultural policies which have reduced international agricultural commodity trade to a mere carrying out of governmental import and price policies.

My comments today have probably done nothing much to bring us closer to the formulation of a coherent economic policy for the future. My purpose was, rather, to emphasize that the world agricultural situation as it is related to economic development and changing economic patterns calls for a sobering reappraisal of accepted notions. It calls for the recognition of the fact that world agriculture and agricultural world trade are not moving in the direction of a return to the free-market economy. Rather, they imply an increasing degree of market management on an international basis.

It is fortunate that among the great variety of talents which combine to make the U.S. Department of Agriculture what it is there are enough specialists and students to master and—given a fair chance—formulate workable solutions to these problems.

The United States has historically been placed in a position to exert leadership in the free world and, to a considerable extent, in the world at large. But it can only exert that leadership in directions which are consistent with the trends and the requirements of world economy and with the needs of emerging nations. What the world needs today is a comprehensive network of international arrangements covering the production and distribution of food—what our federation has called an international food and farm policy, integrating food aid in an overall program of economic and technical assistance to developing countries under the aegis of the United Nations.

Discussion—Continued

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IT IS FITTING, it seems to me, before considering this topic, to be reminded of the historic background against which the agricultural situation of every country in the world has developed and formed its particular pattern. For many reasons, and more particularly to insure a reasonable return to its farmers and regular supplies to its consumers, every country has felt compelled to give one kind of protection or another to its agricultural production. This is usually achieved by guaranteeing a minimum return to the producers, by imposing import quotas, tariffs, or other forms of trade protection, on one side, and by granting some export subsidies or other kind of assistance to agricultural exports, on the other hand.

We are thus fully aware that the pattern of agricultural production and agricultural trade in a great many countries is largely artificial and mostly manmade. Man can, therefore, by changing these artificial conditions of production and/or by removing partially or completely the trade barriers within the boundaries of a group of countries, create different economic circumstances, which will bring about modified economic patterns and thereby change the agricultural situation in many countries, directly or indirectly affected. In this respect, several important developments have occurred in recent years.

International Agreements on Agricultural Commodities

Such agreements have been concluded for several items such as wheat, sugar, coffee, and the possibilities of agreements on other commodities, such as feed grains and butter, have been investigated and are now under review.

International agreements on agricultural commodities are sought to bring about stability of prices and stability in world trade. They thus tend to maintain economic patterns "as they are." The Honorable Mr. Hamilton, Canadian Minister of Agriculture, recently proposed a more extensive use of commodity agreements to "bring a rule or law into the area of subsidized competition in export market."

Underlying the necessity to bring about stability in prices and markets on the international plan, as the International Wheat Agreement has proved possible in spite of huge surpluses overhanging the market, there is now a trend to extend such international agreements to more agricultural commodities, such as dried milk, cheese, bacon, apples, soya, to mention only a few.

A World Food Program

The old idea of a world food board, which became a world food bank and is now the World Food program, received new impetus at the initiative of Canada at the last FAO meeting held in Rome at the end of last year. Speaking as the head of the Canadian delegation, the Honorable Mr. Hamilton, Minister of Agriculture, expressed the view, generally shared by many other countries, that "the concept of a world food bank must be based on the need of people for food, not on the need of countries to dispose of surpluses." Furthermore, the FAO Conference authorized the Director General to put the program into action right away. In addition to the U.S. contribution of \$40 million, Canada promised \$5 million, and Denmark \$2 million. Other nations assured the Conference of their support, but did not specify the size of their contributions. The Conference resolution provided that an international directing committee of 20 nations be established, half of these to be elected by the FAO and the other half by the United Nations.

So, as we see here, we have another international infant still unborn (although already christened), whose impact it would be obviously premature to venture to assess at the present time.

Disposal of Agricultural Surplus Commodities

The desire to succor starving and undernourished people, and to assist the many countries which do not have the necessary foreign currencies to buy food and fibers abroad, coupled with the knowledge that huge surpluses existed in other countries, brought to life two major schemes: the Colombo plan and the U.S. Public Law 480, "Food for Peace," as it is now called.

The Colombo plan is essentially limited to the countries of the Far East and, I think, to countries belonging to the sphere of the British Commonwealth.

The "Food for Peace program" has several interesting features. It includes, indeed:

- (a) Outright gifts in cases such as famine, floods, disaster.
- (b) Barter agreements for strategic materials.
- (c) Sales at concessionary terms, such as long-term loans and payments in foreign currencies.

In general, funds accruing abroad from the sales of U.S. surplus farm commodities are reinvested there in different programs of economic development. Among other uses made of funds are the

support of agricultural research abroad and the financing of marketing developments.

Although great care is taken, and restraint exercised by the U.S. Government—and it deserves to be warmly commended for it—to ascertain that these sales conform to the laws laid down by FAO, I quote: “that they do not interfere with normal channels of world trade,” there is no doubt that they are strongly contributing to the reshaping of world trade and that a new look in this trade will develop in the not too distant future. The tremendous volume of Public Law 480 program (\$7.5 billion since its inception in 1954) is proof enough of its potential influence.

Some countries, exporters of agricultural commodities, have sometimes complained of the “displacement of trade” brought about by the Food for Peace program, in spite of “prior consultation” as is now regularly done. The answer has usually been that markets are being expanded which in the long run will be beneficial to all exporting countries. A noticeable fact already is the new demand for wheat from traditionally rice-consuming countries. It is the avowed aim of the U.S. Government to use the Food for Peace program to expand old markets and create new ones.

Freeman from his testimony before the House Ways and Means Committee, on March 16, 1962:

Our agricultural exports have risen to record high levels—\$5 billion worth last year. Seventy percent of our agricultural exports are being sold for dollars to the more prosperous countries, such as those of the Common Market. Thirty percent are moving to the less prosperous countries under the concessional programs of Food for Peace. As time goes on, we hope that this 70:30 ratio will change in the direction of more exports for dollars in proportion to exports under concessional programs. With economic developments, the “concessional” countries of yesterday are becoming the dollar markets of today and tomorrow.

The Common Market

If we appraise the importance of the European Economic Community, as the Common Market is

officially known, in the light of the following facts, we cannot escape the conclusion that it is nothing less than tremendous. Here are the facts, briefly summarized:

- (a) Following the Treaty of Rome of 1957, the six associated countries, Benelux—Belgium, the Netherlands, and Luxembourg—with three new partners, France, Italy, and West Germany, formed the Common Market.
- (b) Rapidly sensing the potential might of the Six, the EFTA, or Outer Seven, organized under the leadership of the United Kingdom.
- (c) Very quickly the Outer Seven realized that they could not compete with the Six, and their most prominent member, soon followed by others, expressed the desire to join the Common Market. In applying for membership, the United Kingdom made it plain that it wished “to become full, wholehearted, and active members of the European Community in its widest sense and to go forward with you in the building of the new Europe.”
- (d) Even before the United Kingdom’s application for membership, but still more thereafter, the large agricultural exporting countries—whether part of the British Commonwealth or not, became very apprehensive for the future of their trade with the Common Market countries.

Negotiations are taking place between the Common Market and exporting countries of agricultural products. Good will prevailing, we hope and trust that compromises will be achieved—giving complete satisfaction to none, but safeguarding the vital interests of all countries concerned. In so doing, we are confident that, with markets growing and demand expanding in the Common Market, the countries which export agricultural commodities will find it to be a more important and dependable trade partner than they have ever known before.

Discussion—Continued

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SINCE SIR JOHN CRAWFORD gave us an illuminating preview of the future, I would like to take advantage of this historic occasion to take a glance at the past.

When the Department of Agriculture was created 100 years ago, the industrial revolution, which laid the ground for modern economic development, was less than a century old even in its birthplace—Great Britain. It was still in the “takeoff” or “near takeoff” stage, to use Walter Rostow’s ter-

minology, on the Continents of Europe and North America, which were, in modern parlance, economically largely underdeveloped. In the course of the next century, Europe, first western and then much of the eastern part, the United States, Canada, Australia, and Japan were increasingly drawn into the vortex of the revolutionary process which the steam engine initiated and electricity and the internal-combustion engine continued and deepened. I thought it might be worthwhile to

devote the few minutes allotted to me to survey, albeit in a very sketchy manner, the role played by agriculture in this process.

By way of introduction, let me remind you of the intellectual atmosphere of pessimism in which the potentialities of agricultural production were enveloped at the threshold of the industrial age. I refer, of course, to Malthus' famous work, which appeared in 1798,¹ and his thesis of an inevitable gap between an unchecked growth of population and the possible increase of the food supply. Yet the century that followed invalidated Malthusian forebodings as far as Europe was concerned. To be sure, nearly a quarter of a century before Malthus, Adam Smith observed that :

... it may be true, perhaps, that the accommodation of an European prince does not always so much exceed that of an industrious and frugal peasant, as the accommodation of the latter exceeds that of many an African king . . .²

Yet a population of Europe, which more than doubled during the 19th century,³ was better fed and clothed than ever before. The situation was epitomized by a distinguished economic historian, Sir John Clapham :

If the 19th century had done nothing else, it would deserve credit for having first reduced and then, it may fairly be said, removed the age-long dread of famine from the peasants and people of western Europe.⁴

The difficult food situation in western Europe during the two World Wars in the 20th century was merely a temporary setback. Farther east, in Russia, where famine still stalked the land during the first half of the present century, sheer starvation has probably also become a matter of the past. In the west, not only was famine conquered, but a diversification of the monotonous diet of the common man ensued. Wheat bread was substituted for rye and corn and consumption of other foods increased.

As Clapham put it :

You no longer talked of the "black bread of adversity," because black bread was not made in France. The most unfortunate Frenchman ate the white wheaten bread that was served to princes in the Middle Ages, and ate it freely. Besides his abundance of good bread, the average Frenchman during the second half of the 19th century increased his consumption of wine and potatoes by 50 percent ; his consumption of meat, beer, and cider by 100 percent ; his consumption of spirits by 200 percent ; his consumption of sugar and coffee by 300 percent.⁵

To a greater or lesser degree what was said about France was true also of other western countries.

The larger production required to feed better a greatly increased number of mouths is taken for

granted by the present generation, but it would have seemed a miracle to Malthus and his disciples. Let us review briefly how this was accomplished. First was the increased productivity of European agriculture itself. The initial step was the modification or abandonment in the 18th and early 19th centuries of the traditional three-field system of winter grain, spring grain, and summer fallow. In its place were introduced forage legumes, notably clover and other crops, among which stand out those innovations from America—potatoes and, to a lesser extent, corn. Clover, which Mr. Khrushchev now wants to banish in Russia, was particularly important in the days before chemical fertilizer because of its fertilization capabilities. Not only is it a direct source of nitrogen, but it also augments the supply of nitrogen indirectly by increasing the quantity and the quality of barnyard manure. These things, of course, were not understood in the days when chemical knowledge was in its infancy, but the effect was there. The grain yields in western Europe doubled by the middle of the 19th century compared to their very low level prevalent when the three-field system was dominant.⁶ Production was further increased by the substitution of crops, particularly of crops with a higher food value per acre like potatoes for summer fallow in humid regions.

Yields Tilt Upward

Next, with the progress of chemistry and the work of Boussingault, Liebig, and Lawes, chemical fertilizers appeared on the scene and became increasingly important since mid-19th century, and so were improved implements and substitution of mechanical power for animal and human power. Parallel with them came scientific improvement in plant varieties and also in control of plant and animal diseases and pests, thanks to the seminal work of De Bary and Pasteur. Then one must not overlook the spread of irrigation, as in the United States, and its revitalization in older lands as in the cottongrowing regions of Russian central Asia and elsewhere. Because of these various developments, crop yields and production have continued their upward march.

Higher per acre yields was not the only path to increased output. The other was through bringing into cultivation virgin lands, notably in the United States, Russia, Canada, Argentina, and Australia. Not only has this large area of virgin land supplied additional food for the rapidly growing industrial and urban population, but it also provided an important outlet for the surplus farmhands in Europe who were willing to migrate overseas.

¹ *An Essay on the Principles of Production.*

² *The Wealth of Nations*, book I, ch. I, p. 12 (Modern Library ed.).

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⁵ *Ibid.*, p. 402.

⁶ D. N. Pryanishnikov, *Sevooborot i Ego Zanachenie v Dele Podnyatiya Nashikh Urozhaev* (Crop Rotation and Its Significance in Raising Yields), pp. 1–9 (Moscow, 1945) ; *Azot v Zhizni Rastenii i v Zemledelii SSSR* (Nitrogen in the Life of Plants and in Agriculture of the USSR), pp. 134–139 (Moscow, 1945).

The existence of this agricultural frontier, of this tremendous reservoir of good virgin land and settlement, will stand out in history as a unique feature of the western pattern of economic development. This "safety valve," to use Turner's celebrated term, is not available to most of the overpopulated, underdeveloped countries of today, in which population explosion, often accompanied by a revolution of rising expectations, preceded economic growth, thus virtually vindicating Malthus. However, a potent modern agricultural technology, which was developed gradually by "early comers" and which has boosted production per acre and per man so much in the west, is or can be made available now to the underdeveloped countries. Needless to say, this task is not an easy one.⁷

The process of migration and exploitation of the virgin lands and the lively international and interregional exchange which developed would not have been possible without the railroad and the steamship—both children of the industrial revolution. Furthermore, industrialization provided a market for farm products. It thus stimulated commercialization of the previously largely self-sufficient agricultural economies. In turn, industry supplied farmers not only with consumers' goods like textiles, but also with fertilizer, improved implements, fungicides, and other requisites needed to increase farm output. By the same token, domestic industry, like emigration overseas, provided an outlet for the surplus farm labor. Thus we see a close interrelation and mutual dependence between the agricultural and industrial sectors, though the share of agriculture in the national product and labor force usually declines with economic growth.⁸ However, I do not want to give the impression that the road was smooth and not accompanied by many errors, irrationalities, and hardships. All one has to do is to read about agricultural depressions in the 1890's, the 1920's, and 1930's to see the other side of the coin.

Of course, the economic revolution by which agriculture was affected required important institutional changes and adjustments. This is a vast subject, and I can only touch on a few key points. The essential expansion of international trade in agricultural and nonagricultural products would have been greatly hampered without a radical liberalization of the commercial policy of nations, which was so long dominated by mercantilism. The liberalization began with the abolition of the corn laws by Great Britain in 1846. It was promoted by a remarkable series of reciprocal commercial treaties, beginning with the famous Anglo-French Cobden-Chevalier Treaty of 1860.

⁷ Cf. Eugene Staley, *The Future of Underdeveloped Countries*, p. 246 (New York, 1954).

⁸ Simon Kuznets, *Six Lectures on Economic Growth*, p. 56 (Glencoe, Ill., 1959).

When agrarian protection was revived on the Continent of Europe toward the end of the last century, it was, notwithstanding rising tariffs, particularly in Germany, still a relatively moderate form of protectionism compared with what took place during the period between the two World Wars and after. Moreover, so important a trading nation as Great Britain had not abandoned free trade until the interwar period.

Between Waterloo and World War I

The 19th century was also the golden age of international investment which helped so much to provide the social overhead, notably construction of railroads, as well as capital for other phases of economic development in which agriculture shared. International trade and investment and economic development were generally facilitated by the relatively peaceful climate of the century between Waterloo and the beginning of the First World War, despite flourishing imperialism and colonialism. To be sure, there were wars then, too, but they were either short, as the Franco-Prussian War of 1870-71, or were fought on the periphery of the Western World. (The American Civil War was, of course, an exception.) One can only speculate on what our civilization would be like if the 20th century had been as peaceful.

Another institutional factor which cannot be overemphasized is that, looking broadly, agriculture during the last 200 years was characterized by the development of independent family farming. The first part of the 19th century witnessed agrarian reforms which continued the task of emancipation of the peasants that began with the great French Revolution and in some states even antedated it. By the middle of the century, this reform movement spread to eastern Europe. On March 3, 1861, 1 day before Lincoln's inauguration, Alexander the Second, the autocrat of all the Russias, signed a manifesto which abolished serfdom in his domain "forever." Thus, a trend was started which culminated in the supremacy of peasant farming after the revolution of 1917. Let us recall that Lincoln's Emancipation Proclamation and the Homestead Act also dated to the early 1860's.

Another type of agrarian reform, which was still directed at safeguarding family farming, came into vogue in the west during the great depression of the 1930's. This was government intervention to support farm prices and income. It further stimulated technological progress and production and brought to the fore the surplus problem. But in Russia and other Communist lands the anti-thesis of agrarian reform—collectivization—was forced by the Communist regimes to aid their lopsided, hurry-up industrialization programs. It reduced the independent peasant farmer to the status of a low-income state worker or share-

cropper on giant farms. It created food shortages instead of abundance, characteristic of agriculture in the west. In the light of this, it seems to me that, even though the size of farms may con-

tinue to increase, it was John Stuart Mill, a champion of family farming, who pointed to the "wave of the future," and not Karl Marx and his disciples in the east.

Discussion—Continued

Gordon K. Zimmerman

Executive Secretary

National Association of Soil and Water Conservation Districts

I WANT to add my compliments to Sir John Crawford on the excellence of his paper. It is a scholarly, well-documented presentation which clarifies our understanding of one of the great and oncoming issues in world agriculture.

Appropriately, Sir John concentrated his attention on the agricultural and economic development problems of the emerging nations of the world. This has been an area of particular concern at this World Food Forum because it has every prospect of influencing in a major way the future economic and political stability of the world. There are also very important humanitarian and moral values involved in preparing to meet the basic food and sustenance needs of the rapidly expanding population.

Sir John made a very thorough case, it seems to me, why the emerging nations—and especially those in Asia—must depend primarily on a substantial expansion of agricultural production at home. He underscored effectively the reasons why these countries cannot expect to depend in any major way on food imports to meet their needs. For Asia alone (excluding China) he estimated the need for an increase of about 90 million tons of food grains by 1980. He pointed out the barriers—indeed, the practical impossibility—to providing a supply of this magnitude through either commercial or noncommercial trade.

The dependence, he said, *must* be on an increase, and a major one, in domestic food production.

I would like to discuss briefly, by way of supplement to Sir John's thesis, some potentially useful steps toward the desired objectives.

There is a general agreement that the avenue to enlarged production of food and fiber in the emerging nations is increased application of modern technology, of the kind employed so successfully in the surplus-producing and industrialized nations of the world. Reference is customarily made to the genetics of plant improvement, to increased use of fertilizers, to the killing of pests, and to projects for irrigation and drainage.

These are areas of enormous potential, of course, for their contributions to increased production per acre and per worker has been demonstrated convincingly in North America, Western Europe, Japan, and elsewhere.

Along with the application of these elements of production science, however, there is a critical need to learn much more, in the emerging nations, about one of the primary resources which must be depended on most heavily for the required gains in food supply. This is the land itself.

Considering that we will probably continue to depend on the land as the source for most of our future food supplies, we still have a remarkably inadequate catalog of information about it. The gross figures on the extent of arable land in the world have been estimated between 3.04 billion acres (FAO, 1950) and 3.45 billion acres (United Nations, Yearbook, 1959) but there is no particular claim made for precision in these estimates—or for the estimates of arable land in the undeveloped countries. We have general information on perhaps half of the agricultural land resources of the world, and detailed information on much less.

Land and Its Capability To Produce

Based on the experience of the United States and other agriculturally developed countries, there are persuasive reasons to believe that one of the important, initial steps to be taken in preparing for increased food production is to undertake a systematic, scientific survey of the soil (and related moisture) resources available for such production. There is need for factual information about the extent, ownership, and use capabilities of all the agricultural land. Indeed, in some respects this information is a prerequisite, for it should be a determining factor in guiding the application of other production inputs. It provides the means of concentrating capital, labor, and other elements on the lands most suitable for intensive use; and conversely provides a protection against waste and ill-advised applications of effort on soils that are of low or poor productivity.

The survey of soil resources, in general and in detail, would appear to be one of the most fruitful, immediate, and practical ways by which the agriculturally developed nations could assist the emerging countries with their oncoming task.

The second aspect of my discussion bears on the potential value, for the emerging nations, of an agricultural "institution" which has been notably successful in bringing about progress toward conservation, resource development, and production

adjustment during the past quarter century in the United States. These are the soil and water conservation districts.

There are slightly more than 2,900 of these special-purpose districts now established and functioning in all our 50 States, plus Puerto Rico and the Virgin Islands. Their boundaries encompass approximately 96 percent of the agricultural land of the Nation.

For those not familiar with soil and water conservation districts, let me say they are local subdivisions of State government, with responsibilities for developing and operating annual and long-range programs of conservation, wise land use, and resource development within the district. They are chartered by the State only after a favorable referendum of the people concerned.

In the exercise of their responsibilities, the districts seek, utilize, and coordinate the assistance from all available, appropriate sources—private and governmental.

Districts Encourage Leadership and Initiative

Through districts, the farmers, ranchers, and other landowners, and all other responsible institutions and groups in the community, have a means for applying the highest possible degree of local initiative and decision to the management of their own district resource programs.

I am not necessarily suggesting that the emerging nations would want to adopt the precise form of our soil conservation districts. They were developed to meet a particular agricultural need within the framework of the social and political structure of the United States. Either intact or

in some variation, however, the soil conservation district idea recommends itself for wider use. It emphasizes the organization of people locally, for a special agricultural purpose, and underscores the acceptance of responsibility by the people themselves. It sets up goals. The district fosters a feeling of personal involvement and provides an opportunity for personal accomplishment.

The acceptance and use of advanced agricultural technology by the farmers of the emerging countries will be an undertaking of enormous magnitude and difficulty. We all know that the ways in which people do things, and their value judgments, change very slowly. There is a tendency for social institutions to appear static. In order to overcome the inertia that so often stands against desirable reforms and new ventures, it is necessary to encourage a shift in social values and provide new opportunities for the development of acceptable public opinion.

The district idea would seem to lend itself to these requirements. On the basis of our experience with districts in the United States, they not only capitalize on the inherent desires of men to protect and improve their own land for their own families, but represent the means for organized effort in related fields. They have been effective instrumentalities for obtaining group action and for building a community-public opinion in support of district objectives.

To the extent that districts, or some variation of them, can contribute to the establishment of a moral and community climate in the emerging nations that will speed the acceptance of modern technology, they merit our earnest consideration and the consideration of interested governments.

Mr. Eric England: Mr. Moderator, I recall some time ago on another occasion you cautioned us against an explosion of expectation among ourselves as to how rapidly these emerging countries can achieve the changes which we hope for, and you cited the fact, I believe, that it took us over 100 years to arrive with our agricultural institutions at the present stage of progress. We have heard a good deal said about explosion of expectation, or something to that effect.

My question is: What prospects do the members of the panel see now in achieving an international organization which may accomplish something soon enough to prevent the exploding expectations among underdeveloped peoples, in time to prevent a real explosion among them?

Mr. Cardon: Mr. England asked if we are going to be able to do something about it, and can we do it in time? I will attempt at least to offer comment on the pertinent question.

The observation of a centennial always means to me that it is the end of a hundred years, and

when we celebrate the Centennial of the Department of Agriculture we must thereby admit that it has taken us a hundred years for the Department to arrive at its present position; similarly with the land-grant colleges and other agencies or institutions.

I have felt as I have traveled about the world that too often those who would help the developing countries to do likewise, to put it briefly, overlooked the fact that they are not likely to accomplish by next Friday night what it has taken us a hundred years to do. But in saying that I believe that conditions are different, certain things have transpired during the last 20 years which materially change the circumstances.

For example, at the Hot Springs conference and immediately following that conference, which led to the establishment of FAO, there were very, very few Americans who had ever been offshore except in the diplomatic corps or the Armed Forces, and neither of these groups at that time was looking for agricultural problems. When it

came to staffing an international organization, it was extremely difficult to find persons who had the experience in world circumstances either to appreciate the problems as they existed or to be able to work effectively with the people confronting those problems. Since that time literally thousands of competent Americans have traveled widely, and multiple thousands of other people of the world have likewise extended their knowledge of world agriculture. Colonial forces, that were working with this type of problem under colonialism and other forms of government for a number of years before any of these recent movements got underway, while technically competent, were not readily available. Some of those who have had such experience were available, but there were many others who have not had the experience; hence, we had to work largely from scratch.

In the meantime, also, many thousands of people from developing countries have been to European countries, to Australia, to New Zealand, to North American countries, and have had opportunity to see what had been accomplished during these hundred years. Thus, on both sides we who are trying to help today have a much better understanding of the problems confronted by people we are trying to help. Those people also have a better understanding of what has been accomplished in Western Europe, in America, Australia, and elsewhere that might be beneficial to them.

It has been this interchange of people and interchange of ideas, the development of common understanding, which in my estimation is the principal outgrowth of much of the technical type

of work that has been attempted in the last several years.

One further comment. I would say that as important as the technical assistance as we commonly think of it has been—and I am sure you understand that most of my experience has been in the technical field—as much as I think of it and as highly as I regard it, technology in and of itself, we have learned in the last 15 years is not enough. Technology does not thrive except in a favorable social, economic, and political climate; or, we may say, social adjustment is essential if technology is to be effective on a longer term undertaking.

So far as the immediate problems are concerned, I have no misgiving, if I am thinking only in terms of the physical, biological problems. I believe they can be met. But we still lack, in my estimation, a sufficient number of people with the competence in the social-economic field that would be most helpful in making or helping to make or helping to guide the social adjustments that are necessary if technological possibilities are to be realized. Hence, I should say that the great effort that needs to be made in far greater volume than in the past is to seek ways and means of helping countries to meet the impact of technology.

If we think in terms of the short run, of being able to aid them with available or potentially available supplies, we can concentrate on some of the social and economic factors essential to their progress, so that their natural resources may be utilized more effectively. By so doing we would be on a sounder program than in the past.

THIRD PLENARY

"Now for my forecast," said Paul Hoffman in his closing remarks on the above theme. "I believe that 15, perhaps 20, of the less-developed countries will make a breakthrough from poverty to decent living standards by 1970. And nothing is so much needed today as examples of countries which, under free institutions, have such a breakthrough." Other speakers on this closing Plenary Session gave their views on the prospects for agriculture and farm life during the next 10 decades.

AGRICULTURE IN THE NEXT 100 YEARS

Introductory Statement

James Patton, *President of the National Farmers Union*

HAVING SPENT my life in agriculture, I have very mixed emotions about our successes and failures. In this great land of ours we started with millions of acres of free land.

In 1862 we created a land-grant-college system, a great experimental research system, later a demonstration system of extension and education. After 100 years we find farmers are the low people on the totem pole, the lowest paid people, the people who produce the food and fiber on our land.

Now in looking to the future it seems to me that science will be the architect of agricultural production and capital will be its handmaiden. To me, this means one thing, that the most important

element in the future will be man himself, and what we do in agriculture is important primarily in terms of what agriculture does for humanity and what happens to people engaged in agriculture.

It seems to me that the topic for this morning's session is extremely important because, while the past is prolog, and vitally important, as we look to the future we are faced with a technological revolution of substantial proportion. We have a great responsibility, as I see it, in the next 100 years, to create as great a revolution and as great a change as we have in the past.

Agriculture in the Next 100 Years in Industrial Countries

John T. Caldwell¹

***Chancellor, North Carolina State College, and
President, Association of State Universities and Land-Grant Colleges***

THE RECORD of change in the agriculture of the United States, Canada, Europe, Australia, and New Zealand over the past 100 years is clearly written. The record compels you and me to adopt a disciplined humility about saying what can happen in the century ahead. Throughout all the

developed countries, the past century has brought unbelievable increase in productivity per worker and per acre of land.

One hundred years ago almost 60 percent of the total work force in the United States was employed in agriculture. Today the comparable figure is slightly more than 8 percent.

In the last century the population of the United States grew nearly six times. Yet the number of people engaged in supplying this population with

¹Prepared with the invaluable assistance of Prof. James G. Maddox, Department of Agricultural Economics, North Carolina State College.

food and fiber actually decreased—from 7.3 million to 7.1 million.

In 1860, on the eve of this revolution in agricultural production, the intellectual leadership of the Western World was still under the influence of Thomas Robert Malthus and his doctrine that population must outstrip food supply. Even the best social scientists of that period held that we were on the verge of a "stationary state."

Surely, we believe, our predictions of the next 100 years cannot fall so woefully short!

The one large fact these illustrious minds of the last century failed to grasp was the enormous power of scientific understanding. Once man understands Nature, his power to extend Nature's potential defies limitation. The finding of knowledge and the exponential rate of expansion of it, plus the systematic spread, adaptation, and application of it, has made affluence a reality and poverty potentially extinct.

At this moment the human race stands on a platform of accumulated knowledge and established know-how which is vastly broader and more deeply supported than a century ago. Furthermore our instruments and techniques for expanding this mass of knowledge and understanding are many times multiplied over our earlier crude abilities. Finally, our present awareness of the power of knowledge and technique impels us to devote more and more resources into research and development.

Who knows, then, what may come from the next manipulations, of germ plasm, from new insights into the character of the living cell, and from our researches into the nature of space and the plasma!

If we are to predict with any reasonable degree of accuracy the course of agricultural development in the developed countries during the next 100 years, we must predict the number and kind of new discoveries that will be coming from the minds of our scientists and their productive uses. Unable as we are to unlock the minds of scientists not yet born, let us acknowledge that we have little more than a probability of foreseeing the next years with any more validity than did our predecessors a century ago who predicted a plateau of accomplishment and eventual shortage of food.

A Century of New Enlightenment

The best we can do is to point out some major directions of change without attempting to measure the rate or to project a timetable. We can be sure that people of the developed countries will still be hungry for knowledge, as indeed, all the world will be. Nations and individuals see knowledge as a source of power, of private gain, of national strength, of personal satisfaction. The next century therefore will be the century of new enlightenment, perhaps, the Century of the Educated Man.

With regard to agriculture, present trends are not likely to be soon reversed, if at all. The need

for agricultural land and farm labor in the developed societies will continue to shrink. This trend has been evident for some years. In the United States our agricultural output more than doubled in the past 50 years on no larger acreage of land. And less than half the farm labor of 50 years ago was required to produce this happy result. This revolution has resulted from improvements in technology calling for increases in the amount of capital used in agriculture substituting for farm labor. The use of mechanical power and equipment increased fivefold. Inputs of fertilizer and lime increased more than 800 percent.

Similar trends are evident in Western Europe where total agricultural acreage decreased 2.6 percent between 1910 and the midfifties.

If these trends toward more capital and technology continue, which they surely will do, some of the results will be—

- Greater specialization in agricultural production among farms and by areas;
- Increased capital requirements;
- More complicated management problems for farmers; and
- An unavoidable pressure toward greater coordination between the flow of productive materials to the farm, the farming operations, and the processing and distribution of farm products.

What will these farms of the future look like? Will they be commercial ventures resembling "factories in the field"? Will there be family farms in 2062? Again, let us look at the trends.

Within the past decade is clear evidence in this country that family-operated farms of adequate size increased in number. (By "adequate" is meant those marketing at least \$10,000 worth of products.) Larger farms and small family farms decreased in number. Between 1949 and 1959—

- Adequate family farms increased in number 104 percent.
- Small family farms decreased 50 percent in number.
- Larger than family farms decreased 36 percent.

For the foreseeable future it is evident that the family-operated farm will continue to grow large and more complex. It is also predictable that there will be fewer Americans earning their living from cultivating the land.

The status of the family-size farm cannot with confidence be projected for a full 100 years. We believe, however, that there will be considerable survival with strength. The healthy survivors will be larger in terms of output per man; in other words, sounder economic units, which is a more meaningful measuring unit than acreage.

So great is the productive potential in the developed countries, the problem of agricultural sur-

pluses is not likely soon to disappear. The withdrawal of units of capital from the total agricultural enterprise sufficient to produce a balance with demand will be quite slow. This fact calls for further comment.

Consumers, the Beneficiaries

In the past 100 years the thrilling advances in agricultural production have measurably benefited the consumer. The availability and cost of food to the average citizen of the developed countries have steadily moved in his favor. The very existence of surpluses of food is a boon to humanity, a strength to a nation, a condition of undoubted merit in terms of human welfare. The objectives of research and education and promotion have combined to produce this result. The consumer has been the beneficiary. What, though, of the producer? Has he shared comparably in the results of his achievement? The answer must be negative.

Not only is the average income of nonfarm multiperson families persistently higher than that of farm families (in the United States, 80 percent higher), over 58 percent of farm operator families received a less than adequate income of \$4,000 annually, whereas only 19 percent of the nonfarm families were so found in 1960. Rural poverty is still too extensive even in the developed countries to escape attention.

One can predict, then, that society's goals for agriculture, without neglecting continued efforts at increased production, will include a larger concern for the farmer: a fairer reward for his inputs of capital, management and labor, and, hopefully, the virtual elimination of rural poverty.

Economic policy to these ends will develop along complex lines. Repeated efforts will be made at solving the agricultural surplus problem through external "controls." There will perhaps be some further loss of freedom for the individual farmer in the decades ahead from both reasonable and unwise efforts at production control. But the largest restrictions on his enterprise will be of a different character and will derive from his own management decisions.

The economics of production, processing, and marketing will produce more and more arrangements for articulating these three processes (production, processing, marketing), arrangements

which are voluntarily and consciously devised and agreed upon by individual entrepreneurs, such as contract farming and vertically integrated organizations. These agreements will occur between farmers and farmers, between processors and farmers, and among competing enterprises. Thus the economics of competition and survival will affect the agricultural sector vigorously. Traditional self-reliance and desire for independence will survive, but self-protective alliances will change the structure of the farm economy.

Surely the developed countries of the world will continue to possess and expand their vast storehouse of knowledge and productive resources. Improved varieties, greater knowledge of plant and animal nutrition, more effective control of pests and diseases, greater utilization of machines—all will continue to characterize advanced agriculture.

With these possibilities at our command, however, must we not ask how they can best be used for mankind. Possible directions include—

Shifting some resources out of agricultural into more needed efforts;

Continuing the production of surpluses and shipping the excess to deficit areas; or

Directing some of our resources, especially knowledge and know-how, to the developing and underdeveloped areas.

The last direction offers the greatest challenge to the developed nations by which they help the developing nations in their own prodigious efforts to promote change and raise the standard of livelihood for their people. In this effort the American "land-grant college" idea offers magnificent promise.

Hunger Can Be Banished

The century ahead offers the possibility that hunger can be banished from the world. It can come to pass if the agricultural scientists and technicians of the developed societies turn their attention and talents worldwide to the exciting lands of undeveloped potential and evident need.

We are in for change and more change. The right kind *must* be encouraged and promoted with resulting human progress.

Indeed, this will be done.

We invite the next century with confidence into the living experience of the thinking farmer.

Mr. Patton: Our next subject to be introduced is "Agriculture in the Next 100 Years in Countries in Transition." It has seemed to me in thinking about this subject, that a country like America has increasing difficulty in learning how to join

the revolution which is going on in the world, the revolution against poverty. It is a revolution which involves us whether we like it or not; it involves major institutional changes.

Agriculture in the Next 100 Years—Countries in Transition

Paul G. Hoffman

Managing Director, United Nations Special Fund

I ACCEPTED perhaps too quickly the invitation to address you because I am far from being an expert in agriculture. However, all of us instinctively like to say yes when Secretary of Agriculture Orville L. Freeman asks us to do something. Further, I thought it would be most interesting to speculate on the agricultural situation 100 years hence.

I turned to friends who have given much thought to the future of agriculture for assistance in this exercise of crystalgazing. I came out with nothing even resembling a consensus. One friend expressed the view that 100 years from now this world of ours would be so crowded with people that almost all of our food would have to come from the sea, from fish and algae. Others felt that by the year 2062 nearly all food would be raised by gentlemen farmers who would sit in their luxurious offices and push a button here and a button there.

It was only when I took a backward look that I obtained real light on the subject. I decided to find out what the founders of the Department of Agriculture had in mind when they proposed this Department just 100 years ago.

They could not have dreamed of the state of agriculture in the United States today. But they had a basic idea, and an excellent one: that knowledge about agricultural needs and problems should be enlarged, and that its application should be extended. Out of this came major research and reporting activities, the land-grant colleges, and farm extension services. Certainly the results of the application of that formula have been astounding. And at this celebration of a century of incredibly far-sighted and useful work by the Department of Agriculture, we must all express our pride and gratitude in this immense heritage. My experience is in the industrial, not in the agricultural, field. As an industrialist I felt very smug about the accomplishments in industry in promoting manpower productivity. I got quite a shock a short time ago when I learned that for the past 20 years manpower productivity in the United States has been rising $2\frac{1}{2}$ times faster in agriculture than in industry.

Where this same formula of increasing knowledge and extending its use might take agriculture in the United States during the next 100 years, I do not know. I say "might" take, because in this shrinking world, events outside the United States are quite apt to be the controlling influence. I will go further and say that what happens in the next 10 years—not the next 100, but the next 10 years—in the underdeveloped countries may well become the vital factor—not only in our agricultural future but in the entire future of all the

agriculturally and industrially advanced countries.

Half a century ago I was told that in facing any situation it was essential to "get the fact or the facts will get you." There are three exciting facts about the world today which should be faced squarely and courageously:

The first fact is that more than one-half of the world's people living in 100 low-income countries and territories are in active revolt against continued acceptance of hunger, poverty, illiteracy, and ill health. If there were any way for you to see life in these countries as I have through visits to many of them in the past few years, you would be as concerned as I am about the situation. I can only hope to convey to you some sense of the seething unrest of the people of these poor countries, some hint of the intensity of their determination to better their conditions, and some idea of their understandable impatience. That impatience can lead to more Congos, more Cubas, and perhaps to general chaos as well. But it need not!

The second fact is that we have no time to lose. Development is historically a long as well as an arduous task. But the pressure of demand today is so great that time is lacking for the slow development which was characteristic of most of the industrially advanced nations. The processes that took centuries for us must be compressed into decades for the underdeveloped world. The facts of modern communication make the times, and time itself, more pitiless today than ever before.

The Sixties, a Critical Decade

By unanimous vote of its more than 100 member nations, the United Nations General Assembly designated the 1960's as the United Nations Development Decade. It is in *this* decade that we must build the momentum that will insure a world without acute want by the year 2000. It is in *this* decade that development must be speeded—primarily as a result of intensified activity on the part of the poor countries themselves. But we will all have to help. We must prove in this decade that the one enduring way to speed development is through dynamic evolution—and not through violence.

The third fact is that the physical and human resources *are* available in almost all the low-income countries to bring to the peoples of those countries lives of decency and dignity. With every passing day at the United Nations new evidence comes to light of the enormous potentialities in the form of physical resources, of great rivers whose waters are hardly being used, of tremendous forests that

have never been inventoried, of mineral wealth that has never been tapped.

Particularly impressive are the little used agricultural resources of these countries.

Take the case of India. Here is a country that today is importing food in tremendous quantities. Yet a group of agronomists who were in India about 4 years ago concluded after a study of Indian conditions that India had the soil and water not only to feed well its present population, but twice its present population. With better control of water, and with fertilizer, improved seeds, and modernization of agriculture, India will get that tremendous increase in food. If this sounds unbelievable to you, let me say that the average North American farmer produces 10 times as much as a farmer in Asia, and 20 times as much as his counterpart in Africa. There are many factors that enter into this, but it does give you some idea of the *potential* of the land and water in these countries.

Let me give another specific example from another country—Ethiopia—and again in the vital field of increasing agricultural output. One of Ethiopia's principal rivers is the Awash. Here, too, its waters have been used but little and yet preliminary studies indicate that, with control of the waters of that river, the Awash Valley can become one of the more fertile valleys in all of Africa. In fact, the prospects of this are so bright that a British syndicate signed an agreement with the Ethiopian Government to supply \$35 million of capital for a settlement project in the valley, provided the intensive soil and water-use survey, now underway with United Nations assistance, measures up to the preliminary findings.

In the uncovering of these physical resources, new technology, modern science, and research have a great part to play. Thus, the Special Fund, with the cooperation of UNESCO, is using computers to construct a "mathematical model" of a dam to control the devastating floods occurring in the Lower Mekong River Basin. If the computers' calculations indicate that the proposed earthworks dam would justify its cost by protecting rice and other crops, the project will move into the design stage. A contrary answer, on the other hand, would divert attention to more likely sites for flood-control installations.

In Sudan, to give another example, the Savannah comprises one-third of the total land area, which is characterized by low and erratic rainfall and a vegetation of grasses and savannah forests, including gum acacia. Over the last few decades the rising human and animal populations have brought about a steadily increasing pressure on the land and water resources. This has led to denudation of forest areas, overgrazing, concentrations of exhaustive cultivation, symptoms of overstrain on underground water resources, and fears of serious soil erosion. The government, viewing this development with increasing concern,

is with United Nations special assistance tackling the problem on two fronts: Firstly, by surveying the soil and water resources of a representative area of the Savannah; and secondly, by conducting research and training as a necessary preliminary to an extensive reafforestation and forest protection program. The survey is being carried out over a 6-year period, starting with an aerial photographic survey with sufficient ground controls to produce suitable maps of the project area showing soils, present land uses, vegetation, hydrology, etc. From these maps, pilot areas will be selected for practical trials and demonstration of various methods of land use and conservation so that the capabilities of the resources can be properly classified in relation to the maps. Fieldwork will also be conducted into problems of safeguarding existing water supplies and locating new ones. The objective of the survey is to determine technically sound measures of land use and conservation which are also feasible in terms of cost, administration, and impact on the way of living of the population.

Without doubt the uneven allocation of the gifts of Nature will make development more difficult in some areas than in others. It will certainly influence the direction which development will take, encouraging animal husbandry here and rice culture there, making coal a source of power in one area and oil in another. The pace and pattern of change must inevitably reflect the variety of natural habitats in which it takes place. Viewing the problems as a whole, however, many more surveys, such as those I have described, are required as a basis for sound development programs. Underdeveloped countries, generally speaking, are not poor in resources; they are simply poor in knowledge of their resources.

As far as the physical resources of the low-income countries are concerned, I think that I am safe in saying that in those countries there is a need for not less than 1,000 major investigations of the potentialities of their land for increasing agricultural output and for mineral development, and of their waters for irrigation, power production, and fishing. Happily, with the new techniques now available, the problem is greatly simplified to one of money, availability of experts, and time.

Physical Resources Are Available

There is no doubt in my mind that the *physical* resources exist to produce reasonably comfortable living standards for the people of the underdeveloped world throughout the next 100 years.

All during this past century orators have been telling us that the great resource of any nation is its people. That's emphatically true, but it must be qualified by one word: "potential." That great potential can be realized only with education and training.

Of the 1.3 billion people now in the 100 underdeveloped countries associated with the United

Nations, I would guess that around 750 million of those at or over school age still cannot read or write. It would be good if they could, but even that would be far from enough. Scores of millions of these people must be given secondary education as well. There are also immense needs for vocational training. And finally, as an overriding factor in economic development, we have the necessity of training vast numbers of people for highly skilled occupations. As a conservative estimate, I would say that our 100 underdeveloped countries need to train 1 million people as rapidly as possible for such posts—top-level administrators, professional personnel, management and business executives, and middle-level technicians for building and industrial programs, for health services, teaching, and for supervisory positions in government and industry.

It has been dramatically demonstrated that education has not only a cultural but a cash value. Perhaps no single person has done as much to point out the importance of human investment as Theodore Schultz of the University of Chicago. In a recent paper he stated: "... perhaps the greatest capital formation that has been going on in our society is our investment in ourselves. It may be that these investments in ourselves—in our abilities, our talents and capacities, in our stamina, our health, the way we live and what we eat—are the very kinds of capital that make the greatest return in terms of reward for our efforts."

Behind the spectacular development of American agriculture has been the education of the people who work on the land. Thus it is largely due to education, training, and human ingenuity that in the United States a single farmer typically produces enough food for himself and for 23 non-food-producing citizens. As recently as 1940 he produced enough for 11. But in different parts of Africa, it takes from 2 to 10 men, women, and children to produce enough for themselves and only 1 non-food-producing adult.

Human Resources Need Attention

If the aid programs that got underway 10 years ago had given the same attention to human resources that they gave to physical resources, the economies of many countries would be much further advanced than they are today. This was a mistake which we must not repeat, for development cannot proceed without concentration on the increase of human knowledge and skill. And here let me stress that it has been proved time and time again that nationals of all countries can be trained to be good administrators, good businessmen, good doctors, good mechanics, and good farmers.

The task of making more effective use of the human resources of the low-income countries is infinitely more difficult, time consuming, and costly than the surveying of its physical resources and the extension of technology. Accomplishing the

minimum of education and training that is required might take a generation. But here again, the crucial time to make progress is in this United Nations Development Decade. The development of the human resources of the low-income countries is *the* vital ingredient of success in economic advancement.

Another task which must be faced is that of synchronizing agricultural and industrial development. As efficiency on the farm increases, more and more people will become available for other types of activities. Employment opportunities must be available for these people in industry and trade. Industrial development in the low-income countries is also required to employ the people already in the crowded cities of most of those countries, as well as to supply the rural population with products required for agricultural improvement, such as fertilizers, as well as incentive goods and growing markets.

No consideration of the problem of development would be complete without referring to trade policies. Trade policies, of course, directly affect the export earnings of the less-developed countries and thereby their rate of development through their own efforts. The fickle trend of the world market, especially the deterioration in the terms of trade of the low-income countries over the past few years, is well known to all of us. Prices of their exports have fluctuated widely and almost exclusively to the disadvantage of the producers of raw materials and primary products. Earlier this week the United Nations reported that preliminary figures for 1961 suggest that about half the expansion won by primary exporting countries by increasing the amount shipped was lost through lower prices.

Fortunately, there may now be cause for hope that schemes for stabilizing the prices of certain of these commodities will be worked out between importers and exporters in the United Nations, and that, under vigorous leadership, import duties and quotas of the industrialized countries will be liberalized.

Earlier I said that if we don't get the facts, the facts will get us. In this rather awesome task of speeding development, perhaps the most important fact of all—which must be faced by the people of the low-income countries—is that no matter how much technical assistance, pre-investment help, and investment they receive from outside sources, they themselves must bear the overwhelming share of responsibility for their economic and social progress. Theirs is the greater task, theirs the greater sacrifice. External aid has a vital but limited role to play.

Perhaps I can best illustrate this by a reference to the Marshall program. And in doing so I want to recall that development is infinitely more difficult than recovery. The Marshall program has been given too much credit for the achievement of Western Europe's rapid recovery after the

ravages of the Second World War. The program did have an essential part in that recovery. Yet in the year of its maximum assistance, which was 1949, the goods and services supplied from the outside amounted to only 3 percent of the gross national product of the Western European countries. Ninety-seven percent was supplied by the people of the European countries themselves. It was the Europeans who saved Europe. And it is the people of each low-income country who must assure their country's necessary development in this critical decade.

How Best Give Aid, a Problem

The external assistance that is being offered to the low-income countries comes from many sources: international organizations, national governments, private foundations, and religious and other groups. All have their part to play. However, there is need, a very pressing need indeed, to establish criteria for determining the best channel through which aid should be provided. That criteria to me is very clear. We should use the channel that will produce the most effective results at the lowest cost. I have good reason to believe that if this test is used, governments will channel an increasing amount of their assistance through the United Nations.

Under the direction of the U.S. Department of Agriculture, American agricultural surpluses are being put to extraordinarily good use, not only in meeting the immediate problem of feeding hungry people, but also in releasing food which can be used for development purposes. Food surplus from outside the country becomes development aid when it is used as payment for manpower in building roads or other types of public works. It may also serve, when so used, to hold down food price inflation which might otherwise be created by the limited availability of food from the country's own resources. In my opinion we have only made a beginning in putting to good use surplus agricultural products for development purposes. As you may know, the United Nations, in cooperation with the Food and Agriculture Organization, has just embarked, on an experimental basis, upon a World Food program, in which it is hoped that food and other surpluses from a number of countries will be employed with particular efficiency, not only for emergency relief but also in connection with development projects.

This leads me to stress that the United Nations is fortunate in having at its headquarters, in its regional commissions, and in its specialized agencies the most comprehensive array of knowledge and operational experience that exists anywhere for assisting in speeding development everywhere. All of the United Nations agencies have important contributions to make, but particularly heavy responsibility rests on the International Labor Organization, UNESCO, the World Bank, and the Food and Agriculture Organization, whose Freedom From Hunger campaign has been made an integral part of the United Nations Development Decade program.

The international staffs of these organizations of the United Nations family have accumulated rich experience as, over the past 14 years, they have carried out vital research and reporting, brought countries together to share knowledge on crucial development problems, and performed—intelligently, economically, and tirelessly—fieldwork in all parts of the world. I would urge each of you to look more fully into the solid accomplishments and great potentialities of the United Nations in the vital task of promoting development.

In conclusion I would like to summarize what I have been saying and then give you my guess as to the progress which can be expected in the United Nations Decade of Development. I have asserted that in these countries in transition, we are faced with one of the great revolutionary movements in all human history; that progress in this decade in speeding their development, particularly in the agricultural sector, may well be the determining factor in whether the world moves toward peace with justice or towards chaos; and finally, that satisfactory progress can be achieved but only with intensified effort on the part of all the modernizing countries and substantially improved administration of external aid programs.

Now for my forecast, I believe that 15, perhaps 20, of the less-developed countries will make a breakthrough from poverty to decent living standards by 1970. And nothing is so much needed today as examples of countries which, under free institutions, have achieved such a breakthrough. Further, the momentum built up in achieving this goal would assure further gains in the decades ahead and perhaps make a reality of this century's greatest dream—and that is that by the year 2000, poverty, illiteracy, and chronic ill-health will have been wiped from the face of the earth.

Rural Life in the Next 100 Years

Herschel D. Newsom

Master, National Grange

WITHIN THE FORMAT of this World Food Forum—celebrating the Centennial of the U.S. Department of Agriculture—we, of course, must

examine the subject of "Rural Life in the Next 100 Years" in the light of the record of the past, the experiences of the present, and the hopes,

aspirations, and the challenges of the future—as best we may see these, in terms of carefully defined, yet reasonable goals and objectives toward which we should direct our efforts and energies, as well as our skills and other resources.

As has repeatedly been done, in this World Food Forum program, we should here again, in connection with this particular subject matter, take full account of two additional centennials of 1962. The first Morrill Act of 1862 (expanded by the second Morrill Act of 1890) set up land grants, the proceeds from which were to be used for the endowment, support, and maintenance of colleges, devoted primarily—but not exclusively—“to the teaching of agricultural and mechanical arts for the liberal and practical education of the industrial classes.” The teaching of military science was also stipulated in this act. We are here, of course, primarily concerned with the stimulation to education, technology, and indeed to the very development of rural life itself, that came as a result of the contribution that land-grant colleges have made to our rural society, along with those contributions of the USDA.

On May 20, 1862, President Lincoln also signed another historic act that has had great significance throughout the century on the land tenure and the whole picture pattern of our American capitalistic structure which has characterized rural America.

It is not my purpose to dwell upon these three particular centennials. It might be difficult to add to the testimonials in this respect now fresh in your memory. I do certainly commend Secretary Freeman, however, not only for having convened this World Food Forum, but for the magnificent manner in which our Secretary of Agriculture has given public testimonial to the achievements by, and the contributions from, our American agriculture to our total American society and economy.

I likewise salute both Secretary Freeman and President Kennedy not only for having done so much to encourage public recognition of the great and important stature of American agriculture as a tremendous asset to this Nation and to the world, but for their joint recognition of the fact that American agricultural efficiency and productivity are a source of future strength to the free world as well as to America herself.

Standing, therefore, on the heights already attained, we must be prepared now to analyze not only the pattern of rural America—socially, culturally, and economically—but to recognize that this present pattern—yes, the pattern of America and of the world, is in like manner, even now, being formulated as we prepare to embark upon a new century; wherein our challenge seems to give testimonial to the proposition that the only “constant” factor down through the years is *change* itself.

More Than Hope Needed

Standing as we do in a position where we must view with both interest and concern—indeed, with a combination of hope and fear as to the impact and consequences of the inauguration of the common trade policies and practices among six European nations, having banded themselves together in the Common Market—we must do a great deal more than hope. We must examine—and stand ready to modify—our own policies and at the same time seek to influence theirs. In such manner we may enhance the prospect of coordinating our policies with theirs and theirs with ours, perhaps, in such manner as to enhance, rather than to diminish, individual opportunity; move progressively in the direction of the wisest possible use of people, resources, and skills; and thereby improve the prospect of a “fuller life,” for our respective peoples.

We must do more; we must consistently seek ways and means—though it may come more slowly than we can now realize—for attaining these objectives in the *general interest* without inflicting injustice on either groups or individuals.

In carefully estimating our course for the future, it likewise is clear that the very title of this Centennial program, “World Food Forum,” suggests that we must seek also to utilize the agricultural productive capacity of the more developed areas of the world, including our own, to stimulate further development in the “developing” countries.

The headlines of yesterday and today, and I suspect that those of tomorrow, will likewise give increasing evidence of the futility of even trying to consider what the rural-life pattern in the next 100 years may be—or what we would like to have it be—without recognizing that even as the agricultural productive capacity in the United States has been a major factor in the total development of America, so must we be concerned that no reasonable opportunity is lost to influence the institutional aspects of agricultural development and to emphasize the importance of education, technology, and the other factors which can influence the pattern of agriculture and of the total society of these developing nations in the decades to come.

Recognizing that prosperity springs from the production of new wealth, and being cognizant of the fact that agriculture in all lands is *the* substantial producer of new wealth, it would seem impossible that reasonable men, in any land, should let the “primacy” of their agriculture escape their minds. Nor does it seem that any nation should willingly permit its most dynamic and efficient new wealth producers to suffer from low and inequitable return on investment, management, and labor.

The fact that farmers do so suffer—coupled with the fact that farm programs of the past 30 years have not corrected the low farm income problem, even as they have become subjects of controversy because of excessive cost and their very tendency

of denying farm products reasonable access to the markets of the world—should dictate greater progress toward revision of our own legislative structure.

Individual and family opportunities, and the reasonable constructive development of human and institutional resources during the next hundred years in the “developing” and in developed and industrialized countries alike, will be dependent upon the extent to which we are able to reconcile legitimate individual interests, on the one hand, with group interest, as well as the well-being and progress in national, regional, and international affairs in the days ahead.

Rural Life in the Next 100 Years, in America, and in the world, will not be determined in our own minds; though individual skill, energy, and devotion will become increasingly important.

Our individual well-being and progress will not be determined entirely by ourselves—either as individuals or nations; though without appropriate individual effort and wise national policy, there will be no hope for progress.

New Responsibilities in the Decades Ahead

This must not mean a diminution of the importance of the individual; nor of his own intelligence and productive efficiency in determining his future. It does mean, however, that whereas the acceptance of individual citizenship responsibilities were essential and in large measure, reasonably sufficient, in the infancy of our Republic, rural Americans and their fellow countrymen in other walks of life will be well advised to accept group,

regional, national, and international responsibilities during the decades to come. We will only be able to fulfill our destiny and meet the challenges of the next 100 years if we, ourselves, develop in such manner as to keep pace with the evolution all about us; stimulating ourselves as individuals, of course, but at the same time developing our organizational and institutional structure that we supplement each other, concerning ourselves always with the necessity, as well as the wisdom, of carefully and wisely, but, nevertheless, progressively and consistently seeking ways of utilizing our own skills and productivity to meet the health and nutritional problems of the world, and at the same time stimulate abilities everywhere to make further contributions to rural and national life of all peoples.

The estimated one-third of the world's people who have recently achieved political independence will surely be vigorously seeking progress toward Freedom From Hunger very early in the next 100 years.

In such manner, we may give credence to a statement by Leonardo da Vinci of approximately five centuries ago, that “He who would lead the world in peace must begin by being a farmer.” At least it seems clear that we in the United States must take clearer cognizance of the changed and changing status of American agricultural exports in the world than we have been taking in recent years.

The fabulous productive efficiency of American agriculture alone would dictate this necessity. A rising international consciousness, to say nothing of our own best self-interest, calls for no less.

Closing Remarks

Frank J. Welch

*Assistant Secretary
U.S. Department of Agriculture*

I AM SORRY indeed that the Secretary could not be here as planned to say a few words to you and to close this World Food Forum.

Unfortunately, he was held up at the White House, and we are presuming at this time that he will not be able to be with us for this closing session.

I think this World Food Forum has provided an excellent impetus in our activities associated with the celebration of the Centennial of the U.S. Department of Agriculture, and the land-grant colleges.

In hearing the discussions and presentations of the past 2½ days, certain significant points have emerged, and I am going to mention only a very few of those:

First, that agriculture will be a powerful force in the era of development that lies immediately ahead.

Secondly, that the science of agriculture can conquer man's oldest fear, that of hunger and want—not only for a few nations and a few fortunate people, but for all nations and all people.

And thirdly, the task ahead is to relieve the individual needs of the newer countries by helping them to institute the technology which has already brought to our own nation an era of abundance to the extent that we have been able to eat well and share with other people.

As Sir John Crawford so effectively pointed out, the regions of greatest need at the same time are the regions where population is growing most rapidly.

And you heard Mr. Paul Hoffman say this morning that the underdeveloped countries, generally speaking, are not poor in resources; they are poor in their knowledge of the resources they have and how they may develop and utilize them in terms of the needs of their own people.

What a great challenge this is to those of us who have it in our power to extend agricultural science to help other nations who have special needs for development of their own resources.

What a challenge, if you please, to help develop the human resources, as well as the physical re-

sources, for we have in our power to extend help that will conquer problems of illiteracy. We can help with vocational training, and other aspects of social development that will enable all nations to make the most effective use of all of their resources for the good of all.

While the World Food Forum was formally ended by Dr. Frank Welch, Chairman of the Centennial Committee, at Sheraton Hall on Thursday noon, three events were scheduled in the afternoon:

(1) President John F. Kennedy spoke to a group of speakers in the Rose Garden at the White House. His remarks appear on page iii.

(2) A bus tour to the Agricultural Research Center at Beltsville, Md.; and

(3) A bus tour to the University of Maryland, one of the oldest land-grant institutions in America.

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